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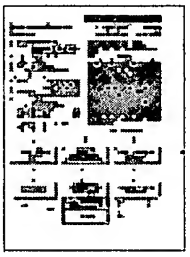
Title: **JP2000123138A2: CONTACTLESS COMMUNICATION MEDIUM, CONTACTLESS INFORMATION READING AND WRITING MACHINE AND CONTACTLESS COMMUNICATION SYSTEM**

Derwent Title: Non-contact communication medium for automatic ticket inspection, disconnects resonance circuit loop, when signal from non-contact IC cards deviate from stored signal of non-contact information [Derwent Record]



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SOLUTION: This contactless communication system includes the contactless communication media 2a and 2b which receive the inquiry signals including the user identification information which specify the media 2a and 2b and cut their own resonance circuit loops if the stored user identification information are not coincident with those included in the received inquiry signals and a contactless information reading/writing machine 1 which transmits the inquiry signals including the user identification information specifying the media 2a and 2b and receives the answer signals from the media 2a and 2b having their stored user identification information which are coincident with those included in the received inquiry signals to execute the contactless communication.

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(54) CONTACTLESS COMMUNICATION MEDIUM, CONTACTLESS INFORMATION READING AND WRITING MACHINE AND CONTACTLESS COMMUNICATION SYSTEM

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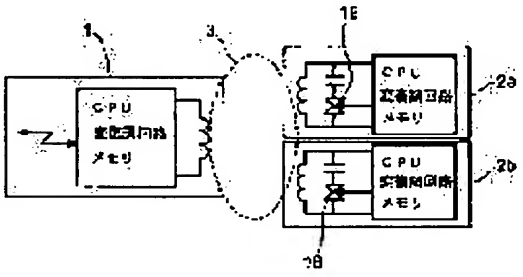

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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The resonance circuit used for the non-contact communication link with non-contact information read-out / write-in machine is provided. The question signal transmitted from non-contact information read-out / write-in machine including the user-identification information on the contents that non-contact communication media are specified is received. Non-contact communication media characterized by being the configuration of cutting one's resonance circuit loop formation when the contents of the user-identification information which oneself has memorized, and the contents of the received user-identification information which asks and is included in a signal do not agree.
[Claim 2] Non-contact information read-out / the write-in machine characterized by to be the configuration of performing a non-contact communication link after receiving the reply signal transmitted from the non-contact communication media with which the contents of the user-identification information including the user-identification information on the contents that non-contact communication media are specified which asked, and transmitted the signal and oneself has memorized, and the contents of the received user-identification information which asks and is included in a signal agreed
[Claim 3] The resonance circuit used for the non-contact communication link with non-contact information read-out / write-in machine is provided. The question signal transmitted from non-contact information read-out / write-in machine including the user-identification information on the contents that non-contact communication media are specified is received. The non-contact communication media which cut their resonance circuit loop formation when the contents of the user-identification information which oneself has memorized, and the contents of the received user-identification information which asks and is included in a signal do not agree, A question signal including the user-identification information on the contents that non-contact communication media are specified is transmitted. Non-contact information read-out / write-in machine which performs a non-contact communication link after receiving the reply signal transmitted from the non-contact communication media with which the contents of the user-identification information which oneself has memorized, and the contents of the received user-identification information which asks and is included in a signal agreed Non-contact communication system characterized by having.
[Claim 4] Non-contact communication system characterized by containing the category code which limits the candidate for use of non-contact communication media at least in each with the user-identification information which the user-identification information and non-contact communication media of the question signal which is the non-contact communication system indicated to claim 3, and non-contact information read-out / write-in machine transmits have memorized.
[Claim 5] It is the non-contact communication system which is the non-contact communication system indicated to claim 3, and is characterized by including information required for passage authorization at least in each with the user-identification information which the user-identification information and non-contact communication media of the question signal which non-contact information read-out / write-in machine is carried in passage regulation equipment, and non-contact information read-out / write-in machine transmits have memorized.
[Claim 6] It is the non-contact communication system which is the non-contact communication system indicated to claim 3, and is characterized by containing the iron road line code and the section code in

each with the user-identification information which the user-identification information and non-contact communication media of the question signal which non-contact information read-out / write-in machine is carried in an automatic ticket gate, and non-contact information read-out / write-in machine transmits have memorized.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to non-contact communication media, non-contact information read-out / write-in machine, and non-contact communication system.
[0002]
[Description of the Prior Art] Since it is necessary for it to be necessary to supply to an automatic ticket gate and after a user picks out a commuter pass from commuter pass ON ** which is a card holder, or a wallet every, whenever it passed the automatic ticket gate installed in the station of a railroad, and to collect commuter passes, and to contain to commuter pass ON **, although the automatic wicket system which uses a magnetic card as a commuter pass or a ticket is introduced from the former at the station of a railroad, for example, this kind of automatic wicket system will take troublesome time and effort. Then, although the non-contact-type automatic wicket system which can pass only by what a user shows an automatic ticket gate a commuter pass to is being put in practical use and the illustration abbreviation is carried out in recent years Non-contact information read-out / write-in machine with which the antenna coil which generates a field was prepared in this kind of automatic wicket system, and the automatic ticket gate which comes to carry the so-called reader/writer (henceforth R/W), The non-contact communication media which perform ticket gate processing, for example, the commuter pass and ticket which are a noncontact IC card, are used by performing data communication between R/W, passing through the inside of the communications area which consists of a field which R/W emits.
[0003] Namely, the noncontact IC card used as a commuter pass etc. With LC resonance circuit which consists of an LC resonance circuit which carries out resonance actuation to the electromagnetic induction by the field which R/W emits being, and generates electromotive force with resonance actuation, i.e., a coil, and a capacitor The power circuit which changes induced electromotive force into self operating power, the demodulator circuit which restores to the command on which the field which R/W generates is overlapped, or data, Have CPU which is the control means which writes in data in memory or reads the data in memory according to a command, and it is constituted. The data which communicate among these noncontact IC cards and R/W are information, such as the entrainment section, an estimated usable period, and close sale-of-tickets record.
[0004] By the way, although the user who changes between two or more iron road lines, or uses the route where the entrainment section was divided even if it is a single iron road line needs to possess two or more noncontact IC cards as a commuter pass If an automatic ticket gate can be passed by showing as they are two or more noncontact IC cards which contain to card holders, such as commuter pass ON ** and a wallet, with two or more noncontact IC cards piled up, and were contained to the card holder For a user, time and effort is not required and it becomes very convenient.
[0005] However, as a result of the coil L1 and L2 comrades which constitute each LC resonance circuit carrying out an electromagnetic coupling and mutual-inductance M's occurring between these coils L1 and L2 for example, since contiguity arrangement of the noncontact IC cards is carried out within the field of R/W when two noncontact IC cards overlap, it will differ from the resonance point omega 0 in case resonance point omega0' of a noncontact IC card to R/W is an independent noncontact IC card. That is, if the capacitors which constitute each of LC resonance circuit are C1 and C2 and it is L1=L2=L

and C1=C2=C, resonance point omega0' in the case of thing-receiving and overlapping whose resonance point omega 0 at the time of the noncontact IC card existing independently is 1/2 0= 1/(LxC) of omega will be set to omega0'=1/(L+M) (xC)1/2. It becomes impossible therefore, to perform data communication among these noncontact IC cards and R/W at the time of the reply to R/W, as a result of change of the current which flows LC resonance circuit of each noncontact IC card decreasing and the received signal level of R/W becoming small.
[0006] The method which loses the electromagnetic coupling of coils is proposed by cutting the resonance circuit loop formation with which detected as the noncontact IC card itself being about two or more sheets overlapping on the need of avoiding such un-arranging, and the noncontact IC card except having been specified is equipped in the sequence set up beforehand. That is, although the illustration abbreviation is carried out, cutting elements, such as a bidirectional switch and an FET circuit, are beforehand incorporated into the resonance circuit loop formation of each noncontact IC card, and it is the method cut as it is also with a cutting element about the resonance circuit loop formation with which the noncontact IC card except having been specified is equipped. And since the resonance circuit loop formation in the noncontact IC card except having been specified will be cut with such a method, data communication will be possible for a mutual inductance occurring among the coils which constitute LC resonance circuit as a result to which it does not happen but resonance point omega0' of each noncontact IC card becomes equal to omega 0.
[0007]
[Problem(s) to be Solved by the Invention] However, it is detected as the noncontact IC card itself being about two or more sheets overlapping. By the method which cuts the resonance circuit loop formation with which the noncontact IC card except having been specified is equipped in the sequence set up beforehand [that the circuit scale of a noncontact IC card increases sharply since it is necessary to add a detection means to detect the overlap of noncontact IC cards, and] It is necessary to add the protocol for determining the priority of cutting sequence when the overlap of noncontact IC cards is detected. And even if it adopts such a configuration, the present condition is that whose dependability over overlap detection of noncontact IC cards is not necessarily high.
[0008] An example is taken inconvenient, it is originated, and this invention does not need to detect such a thing that two or more noncontact IC cards overlap, and aims at offer of the non-contact communication media which can moreover perform positive data communication, with a protocol not added, non-contact information read-out / write-in machine, and non-contact communication system.
[0009]
[Means for Solving the Problem] The non-contact communication media concerning claim 1 of this invention possess the resonance circuit used for the non-contact communication link with non-contact information read-out / write-in machine. The question signal transmitted from R/W including the user-identification information on the contents that non-contact communication media are specified, The so-called polling command is received, and when the contents of the user-identification information which oneself has memorized, and the contents of the user-identification information included in the received polling command do not agree, it is characterized by being the configuration of cutting one's resonance circuit loop formation. R/W concerning claim 2 is characterized by to be the configuration of performing a non-contact communication link after receiving the reply signal which transmits a polling command including the user-identification information on the contents that non-contact communication media are specified, and is transmitted from the non-contact communication media with which the contents of the user-identification information which oneself has memorized, and the contents of the user-identification information included in the received polling command agreed, and the so-called response.
[0010] The non-contact communication system concerning claim 3 of this invention The resonance circuit used for the non-contact communication link with non-contact information read-out / write-in machine is provided. The polling command transmitted from R/W including the user-identification information on the contents that non-contact communication media are specified is received. The non-contact communication media which cut their resonance circuit loop formation when the contents of the user-identification information which oneself has memorized, and the contents of the user-identification information included in the received polling command do not agree, A polling command including the user-identification information on the contents that non-contact communication media are

specified is transmitted. It is characterized by having R/W which performs a non-contact communication link after receiving the response transmitted from the non-contact communication media with which the contents of the user-identification information which oneself has memorized, and the contents of the user-identification information included in the received polling command agreed. The non-contact communication system concerning claim 4 is indicated to claim 3, and it is characterized by containing the category code which limits the candidate for use of non-contact communication media at least in each with the user-identification information which the user-identification information and non-contact communication media of the polling command which R/W transmits have memorized.

[0011] The non-contact communication system concerning claim 5 of this invention is indicated to claim 3, R/W is carried in passage regulation equipment, and it is characterized by including information required for passage authorization at least at each with the user-identification information which the user-identification information and non-contact communication media of the polling command which R/W transmits have memorized. The non-contact communication system concerning claim 6 of this invention is indicated to claim 3, R/W is carried in the automatic ticket gate installed in the station of a railroad, and it is characterized by containing the iron road line code and the section code at each with the user-identification information which the user-identification information and non-contact communication media of the polling command which R/W transmits have memorized.

[0012]

[Embodiment of the Invention] The block diagram which, and is shown, [drawing 1] [the non-contact communication system concerning the gestalt of this operation] [**] [type] The block diagram which, and is shown, [drawing 2] [R/W which constitutes non-contact communication system] [**] [type] The block diagram which, and is shown, [drawing 3] [the noncontact IC card which is the non-contact communication media which constitute non-contact communication system] [**] [type] The block diagram showing the important section configuration of the noncontact IC card which drawing 4 requires for a modification, and drawing 5 are the sequence diagrams showing the processing actuation performed between R/W and a noncontact IC card, each of R/W and sign 2a and 2b shows a noncontact IC card, and, as for the sign 1 in drawing, the sign 3 shows the field. And the flow chart with which R/W is carried in an automatic ticket gate, and the flow chart and drawing 9 which shows processing actuation of the explanatory view in which drawing 6 shows the example of a configuration of a polling command, the explanatory view in which drawing 7 shows the example of a polling command, and R/W by which drawing 8 was carried in the automatic ticket gate show the fundamental processing actuation at the time of a noncontact IC card being a commuter pass, and drawing 10 are the explanatory views showing the difference in actuation between noncontact IC cards, and drawing 11 is the flow chart the applied processing actuation of the noncontact IC card which is a commuter pass be shown.

[0013] It is used as an automatic wicket system and the non-contact communication system concerning the gestalt of this operation consists of noncontact IC card 2a which is R/W1 which forms the field 3 which serves as a communications area after being carried in the automatic ticket gate installed in the station of a railroad, as drawing 1 shows, two or more commuter passes (drawing two sheets) which communicate with R/W1 after minding a field 3, and 2b. In addition, the number of sheets of noncontact IC card 2a which overlaps mutually, and 2b is not restricted to two sheets, and, of course, you may be three or more sheets. And the antenna coil 4 which R/W1 here carries out an electromagnetic coupling to noncontact IC card 2a and 2b as drawing 2 shows, and carries out data communication to noncontact IC card 2a and 2b, The demodulator circuit 5 which restores to them and takes out the response and data which amplified change of the electrical potential difference generated with antenna coil 4, and have been transmitted from noncontact IC card 2a and 2b, The modulation circuit 6 which superimposes the command and data which are transmitted to noncontact IC card 2a and 2b as change of a field 3, It consists of CPU7 which controls actuation by whole R/W1, RAM9 for storing temporarily the access data of ROM8 and CPU7 with which the control program is stored, and a high order interface 10 connected with high order devices (illustration abbreviation), such as a body of an automatic ticket gate.

[0014] On the other hand, each of noncontact IC card 2a in this case and 2b LC resonance circuit which consists of an LC resonance circuit 11 which electromotive force generates as the electromagnetic induction at the time of the field change accompanying migration in a communications area is also, i.e., a coil, and a capacitor 12 as drawing 3 shows, The power circuit 13 which changes into self operating power the induced electromotive force generated in LC resonance circuit, The demodulator circuit 14

which restores to the command on which the field 3 which R/W1 generates is overlapped, or data, The nonvolatile memory 15 which has memorized various kinds of information, such as the getting-on-and-off section and a shelf-life, CPU16 which controls read-out and the writing from nonvolatile memory 15 according to a command, The modulation circuit 17 to which the current which flows LC resonance circuit is changed in case a response and data are transmitted to R/W1, It consists of a bidirectional switch 18 which functions as a cutting element of a resonance circuit loop formation, and usually sometimes continues carrying out ON actuation, and RAM20 for storing temporarily the access data of ROM19 and CPU16 with which the control program is stored.

[0015] In addition, the ON/OFF control of FET21 is to be an analog switch, i.e., the analog switch which comes to use FET21, as a cutting element not restricted to the bidirectional switch 18 and shown by drawing 4 of course, for FET21 to turn on in the configuration of drawing 4 , especially, until a power source starts, and to be carried out by the switch control signal after it. That is, since the switch control signal outputted from CPU16 until a power source starts is still a low level, a forward electrical potential difference joins the gate of FET21, and it has been turned on. And when a switch control signal is a low level after a power source starts, FET21 turns on, LC resonance circuit will be in the condition which can be operated, when a switch control signal is conversely high-level, FET21 will turn off and LC resonance circuit will be in disabling of operation.

[0016] In R/W1 concerning the gestalt of this operation, a command and data are transmitted to noncontact IC card 2a and 2b according to the directions from a high order device. Processing actuation which receives the response and data which have been transmitted from noncontact IC card 2a and 2b, and is transmitted to a high order device is performed. Moreover, especially The polling command with which the user-identification information on the contents that noncontact IC card 2a (2b) was specified was included and which it asks and is a signal, For example, carrying out data communication between noncontact IC card 2a while moving in the inside of a communications area, and 2b, after transmitting the polling command as shows the example of a configuration by drawing 6 and receiving the response which are noncontact IC card 2a and a reply signal from 2b is performed. In addition, in the data communication between R/W1 in this case and noncontact IC card 2a, and 2b, general processing actuation as usual, such as mutual recognition for eliminating the anti collision for preventing processing actuation, i.e., interference, as shown by drawing 5 , and a counterfeit card etc., noncontact IC card 2a, and a memory lead and a memory light to the nonvolatile memory 15 of 2b, is performed.

[0017] By the way, although [the gestalt of this operation] non-contact communication system is used as an automatic wicket system, and R/W1 is carried in a station ticket gate machine and noncontact IC card 2a and 2b are commuter passes, as drawing 7 shows, the iron road line code and the station code are contained in the user-identification information on the polling command in such a case at least. In addition, the station code here means the information for pinpointing the station in which the automatic ticket gate which carried R/W1 is installed.

[0018] Moreover, the user-identification information which comes to contain an iron road line code and a section code also in the nonvolatile memory 15 of noncontact IC card 2a in this case and each 2b is memorized beforehand, and the section code here means the information which is the set of the station code which exists within the entrainment section which can be got on and off as the commuter pass which consists of noncontact IC card 2a and 2b is also, and which was specified for every station. Furthermore, CPU16 which each noncontact IC card 2a and 2b possess It is supposed that ON actuation of the bidirectional switch 18 was freely carried out when the contents of the user-identification information beforehand remembered to be the contents of the user-identification information included in the polling command agreed. The iron road line code and station code which are contained in the user-identification information on a polling command when user-identification information does not agree, When it is judged that the iron road line code and section code which are contained in the memorized user-identification information have not agreed, the control which carries out OFF actuation of the bidirectional switch 18 that noncontact IC card 2a and the resonance circuit loop formation of 2b should be cut is to be realized.

[0019] Therefore, the following processing actuation will be performed in noncontact IC card 2a considered as such a configuration, and 2b. First, after the coil 11 received the field 3 which R/W1 has generated and changing that it is also in a power circuit 13 about induced electromotive force into self operating power, it gets over that it is also in a demodulator circuit 14 about the command and data on

which the field 3 which R/W1 generates is overlapped. And it will be analyzed that the command and data to which it restored are also at CPU16, and a response is transmitted by changing the current of LC resonance circuit in a modulation circuit 17. Moreover, in this case, noncontact IC card 2b (2a) with which the contents of the user-identification information beforehand remembered to be the contents of the user-identification information included in the polling command did not agree will cut its resonance circuit loop formation, and processing actuation succeedingly shown by drawing 5 is performed henceforth. In addition, although CPU16 is used here, it is also possible to realize that hardware is also about such processing actuation.

[0020] Next, the fundamental processing actuation in the non-contact communication system which consists of R/W1, and two noncontact IC card 2a and 2b is explained based on drawing 8 - drawing 10 . In addition, on the need of changing between two iron road lines, the user possesses noncontact IC card 2a which is two commuter passes, and 2b, and presupposes that iron road line codes differ mutually among the user-identification information beforehand memorized by each noncontact IC card 2a and 2b here.

[0021] First, processing actuation of R/W1 carried in the automatic ticket gate is explained, referring to drawing 8 which is the flow chart which shows processing actuation of R/W. This R/W1 forms the field 3 which serves as a communications area based on the directions from a high order device, is superimposed on a polling command including the user-identification information on the contents that noncontact IC card 2a and 2b are specified by the field 3, and is continuing (S1) being transmitted. And it is judged whether transmitting a polling command was being continued and the response was received until it receives a response from the user-identification information included in the polling command, i.e., an iron road line code, noncontact IC card 2a, noncontact IC card 2a with which the iron road line code which the 2b itself has memorized as user-identification information agreed, and 2b (S2). Then, when it is judged that the response was received, data communication by processing, such as processing actuation, i.e., anti collision, as shown by drawing 5 between R/W1 which received the response, and noncontact IC card 2a and 2b, mutual recognition, a memory lead, and a memory light, will usually be performed (S3).

[0022] Processing actuation which is explained below is performed, referring to the flow chart of drawing 9 on the other hand, if it is in noncontact IC card 2a which is a commuter pass, and 2b. First, if noncontact IC card 2a which is usually a commuter pass [that the users approaching the automatic ticket gate with which R/W1 was carried have overlapped since the resonance circuit loop formation was formed with ON actuation of noncontact IC card 2a at the time and the bidirectional switch 18 of each 2b carried out], and 2b are shown in the communications area of R/W1, high induced voltage will occur in noncontact IC card 2a and LC resonance circuit of 2b, and a card power source will carry out ON actuation (S1). However, since two noncontact IC card 2a and 2bs overlap and electrical characteristics change, the communications area in this case is narrow compared with the case where noncontact IC card one of 2a (2b) exists independently. And it is judged whether the polling command transmitted from R/W1 was received (S2). In addition, although the communications area is narrow, that a polling command can be received has both these two noncontact IC card 2a and natural 2b.

[0023] furthermore, in noncontact IC card 2a which received the polling command, and 2b [whether the contents of the user-identification information remembered to be the contents of the user-identification information included in the polling command agree, and] That is, decision whether an iron road line code agrees will be performed (S3), and noncontact IC card 2a (2b) with which the iron road line code agreed transmits a response to R/W1, with ON actuation of the bidirectional switch 18 maintained (S4). In noncontact IC card 2b (2a) which did not agree on the other hand since iron road line codes differed, cutting a resonance circuit loop formation is performed by carrying out OFF actuation of the bidirectional switch 18 (S5). That is, each of noncontact IC card 2a and 2b will perform actuation as shown by drawing 10 in this case. Consequently, although two noncontact IC card 2a and 2bs overlap, since the resonance circuit loop formation of noncontact IC card 2b (2a) is cut, each noncontact IC card 2a and 2b will be in the condition same with existing independently.

[0024] Consequently, it does not happen that coil 11 comrades which constitute each noncontact IC card 2a and LC resonance circuit of 2b carry out an electromagnetic coupling, but it becomes, without a mutual inductance occurring among these coils 11. therefore, the case where, as for overlapping noncontact IC card 2a and the resonance point to R/W1 of 2b, each noncontact IC card 2a and 2b exist independently and abbreviation -- it will be the same, and between these noncontact IC card 2a, 2b, and

R/W1, no un-arranging also has data communication and activation of it is attained. So, between R/W1 which received the response, and noncontact IC card 2a and 2b, data communication by processing, such as mutual recognition, a memory lead, and a memory light, is usually performed (S6). In addition, when a polling command is not received by which noncontact IC card 2a and 2b, either, both noncontact IC card 2a after it will be judged whether the synchronous timing of a polling command and corresponding fixed time amount passed (S7) and fixed time amount passes, and 2b will carry out OFF actuation of the bidirectional switch 18, and will cut a resonance circuit loop formation (S5).

[0025] Furthermore, noncontact IC card 2a which is a commuter pass, and applied processing actuation of 2b are explained, referring to the flow chart shown by drawing 11 succeedingly. In addition, since processing actuation of R/W1 carried in the automatic ticket gate is the same as the contents explained with reference to drawing 8 , it omits explanation. And on the need of using the route where the entrainment section was divided into two although it was a single iron road line here, The user possesses two noncontact IC card 2a and 2b as a commuter pass. It is premised on the division code which shows that these noncontact IC card 2a and 2b use a division route, and the section code being memorized as user-identification information while noncontact IC card 2a and an iron road line code common to each of 2b as user-identification information are memorized.

[0026] If noncontact IC card [that users have overlapped] 2a and 2b are shown in the communications area of R/W1, ON actuation of each noncontact IC card 2a and the card power source of 2b will be carried out (S1), and it will be judged whether the polling command was received (S2). And it is judged whether whether the contents of the user-identification information remembered to be the contents of the user-identification information which the user-identification information included in the polling command will be read as noncontact IC card 2a and 2b be alike, respectively, and was read agreeing, and an iron road line code that is, have agreed (S3). Here, when an iron road line code does not agree, which noncontact IC card 2a and 2b will also carry out OFF actuation of the bidirectional switch 18, and will cut a resonance circuit loop formation, and (S4) and processing actuation end them. Moreover, if the existence of a division code will be judged after reading the division code of the user-identification information (S5) and there is no division code when the iron road line code has agreed, after transmitting a response (S6), data communication by processing will usually be performed between R/W1 (S7).

[0027] on the other hand, when judged as those with a division code, the section code memorized by the station code contained in the polling command, noncontact IC card 2a, and 2b is read succeedingly -- ******** (S8) -- a station code -- noncontact IC card 2a and 2b -- (S9) it is judged to be whether it is contained in which section code. And when noncontact IC card 2b at the time of it being judged that the station code is contained in the section code of noncontact IC card 2a carries out OFF actuation of the bidirectional switch 18, a resonance circuit loop formation will be cut (S10), and noncontact IC card 2a transmits a response to R/W1, with ON actuation of the bidirectional switch 18 maintained (S11). Moreover, if the station code is contained in the section code read in noncontact IC card 2b, when noncontact IC card 2a carries out OFF actuation of the bidirectional switch 18, a resonance circuit loop formation will be cut (S10), and noncontact IC card 2b will transmit a response to R/W1, with ON actuation of the bidirectional switch 18 maintained (S11). Then, between R/W1 and noncontact IC card 2a, and 2b, data communication by processing, such as anti collision, mutual recognition, a memory lead, and a memory light, is usually performed (S12).

[0028] By the way, in the gestalt of this operation, although the non-contact communication system with which R/W1 is carried in a station ticket gate machine, and noncontact IC card 2a and 2b are a commuter pass, a ticket, etc., and consist of R/W1 and noncontact IC card 2a, and 2b is used as an automatic wicket system, use in the example of an application as not limited only to such a configuration, for example, shown below is also possible. Namely, although illustration is omitted It is carried in the passage regulation equipment with which R/W was installed in the high-speed toll gate, the pay parking lot, etc. Noncontact IC cards may be a highway traffic ticket and a parking ticket. under the present circumstances, the user-identification information which the user-identification information and the noncontact IC card of the polling command which R/W which can be boiled and set transmits have memorized -- it is alike, respectively and information required for passage authorization at least is included, if it becomes Even if it is the case where two or more noncontact IC cards overlapped, and are shown, positive data communication can be performed.

[0029] Moreover, there is not necessarily necessity that the non-contact communication system

concerning the gestalt of this operation is used only in an intersection customs clearance staff. As opposed to each with the user-identification information which the user-identification information and the noncontact IC card of the polling command which R/W transmits have memorized When it is also possible to include the category code which limits the candidate for use of a noncontact IC card, such as an object for close leaving and an object for cash drawers, and such a configuration is adopted Even if the noncontact IC card which is a commuter pass, and the noncontact IC card which is an object for close leaving are shown in the condition of having overlapped mutually, it will be distinguished easily, and proper processing actuation will be performed corresponding to an application. That is, it becomes possible to use non-contact communication system as various kinds of security systems by what the application of the non-contact communication system explained above is not limited only to an intersection customs clearance staff, the noncontact IC card is done to registration, such as a password and an ID code, and it does for R/W to check control, such as a password and an ID code. Of course, it may be included in accessories, such as a wrist watch which non-contact communication media were not limited to a noncontact IC card, for example, the user has attached to the body further again.

[0030]

[Effect of the Invention] According to the non-contact communication media, non-contact information read-out / write-in machine, and non-contact communication system concerning this invention Since the non-contact communication media with which the contents of the user-identification information beforehand remembered to be the contents of the user-identification information included in the question signal transmitted from non-contact information read-out / write-in machine did not agree cut their resonance circuit loop formation Even if it is the case where the non-contact communication media of two or more sheets overlap, it does not happen that the resonance point to non-contact information read-out / write-in machine changes, but positive data communication between the non-contact communication media of two or more sheets, and non-contact information read-out / write-in machine can be performed. And since it becomes unnecessary to establish the detection means for detecting the overlap of non-contact communication media, or to add the protocol which determines the priority of cutting sequence when overlap is detected with such a configuration, the advantage that a miniaturization and cost cut of circuitry or the whole equipment can be aimed at is also secured.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to non-contact communication media, non-contact information read-out / write-in machine, and non-contact communication system.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Since it is necessary for it to be necessary to supply to an automatic ticket gate and after a user picks out a commuter pass from commuter pass ON ** which is a card holder, or a wallet every, whenever it passed the automatic ticket gate installed in the station of a railroad, and to collect commuter passes, and to contain to commuter pass ON **, although the automatic wicket system which uses a magnetic card as a commuter pass or a ticket is introduced from the former at the station of a railroad, for example, this kind of automatic wicket system will take troublesome time and effort. Then, although the non-contact-type automatic wicket system which can pass only by what a user shows an automatic ticket gate a commuter pass to is being put in practical use and the illustration abbreviation is carried out in recent years Non-contact information read-out / write-in machine with which the antenna coil which generates a field was prepared in this kind of automatic wicket system, and the automatic ticket gate which comes to carry the so-called reader/writer (henceforth R/W), The non-contact communication media which perform ticket gate processing, for example, the commuter pass and ticket which are a noncontact IC card, are used by performing data communication between R/W, passing through the inside of the communications area which consists of a field which R/W emits.

[0003] Namely, the noncontact IC card used as a commuter pass etc. With LC resonance circuit which consists of an LC resonance circuit which carries out resonance actuation to the electromagnetic induction by the field which R/W emits being, and generates electromotive force with resonance actuation, i.e., a coil, and a capacitor The power circuit which changes induced electromotive force into self operating power, the demodulator circuit which restores to the command on which the field which R/W generates is overlapped, or data, Have CPU which is the control means which writes in data in memory or reads the data in memory according to a command, and it is constituted. The data which communicate among these noncontact IC cards and R/W are information, such as the entrainment section, an estimated usable period, and close sale-of-tickets record.

[0004] By the way, although the user who changes between two or more iron road lines, or uses the route where the entrainment section was divided even if it is a single iron road line needs to possess two or more noncontact IC cards as a commuter pass If an automatic ticket gate can be passed by showing as they are two or more noncontact IC cards which contain to card holders, such as commuter pass ON ** and a wallet, with two or more noncontact IC cards piled up, and were contained to the card holder For a user, time and effort is not required and it becomes very convenient.

[0005] However, as a result of the coil L1 and L2 comrades which constitute each LC resonance circuit carrying out an electromagnetic coupling and mutual-inductance M's occurring between these coils L1 and L2 for example, since contiguity arrangement of the noncontact IC cards is carried out within the field of R/W when two noncontact IC cards overlap, it will differ from the resonance point omega 0 in case resonance point omega0' of a noncontact IC card to R/W is an independent noncontact IC card. That is, if the capacitors which constitute each of LC resonance circuit are C1 and C2 and it is L1=L2=L and C1=C2=C, resonance point omega0' in the case of thing-receiving and overlapping whose resonance point omega 0 at the time of the noncontact IC card existing independently is 1/2 0= 1/(LxC) of omega will be set to omega0'=1/(L+M) (xC)1/2. It becomes impossible therefore, to perform data communication among these noncontact IC cards and R/W at the time of the reply to R/W, as a result of change of the current which flows LC resonance circuit of each noncontact IC card decreasing and the received signal

level of R/W becoming small.

[0006] The method which loses the electromagnetic coupling of coils is proposed by cutting the resonance circuit loop formation with which detected as the noncontact IC card itself being about two or more sheets overlapping on the need of avoiding such un-arranging, and the noncontact IC card except having been specified is equipped in the sequence set up beforehand. That is, although the illustration abbreviation is carried out, cutting elements, such as a bidirectional switch and an FET circuit, are beforehand incorporated into the resonance circuit loop formation of each noncontact IC card, and it is the method cut as it is also with a cutting element about the resonance circuit loop formation with which the noncontact IC card except having been specified is equipped. And since the resonance circuit loop formation in the noncontact IC card except having been specified will be cut with such a method, data communication will be possible for a mutual inductance occurring among the coils which constitute LC resonance circuit as a result to which it does not happen but resonance point omega0' of each noncontact IC card becomes equal to omega 0.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to the non-contact communication media, non-contact information read-out / write-in machine, and non-contact communication system concerning this invention Since the non-contact communication media with which the contents of the user-identification information beforehand remembered to be the contents of the user-identification information included in the question signal transmitted from non-contact information read-out / write-in machine did not agree cut their resonance circuit loop formation Even if it is the case where the non-contact communication media of two or more sheets overlap, it does not happen that the resonance point to non-contact information read-out / write-in machine changes, but positive data communication between the non-contact communication media of two or more sheets, and non-contact information read-out / write-in machine can be performed. And since it becomes unnecessary to establish the detection means for detecting the overlap of non-contact communication media, or to add the protocol which determines the priority of cutting sequence when overlap is detected with such a configuration, the advantage that a miniaturization and cost cut of circuitry or the whole equipment can be aimed at is also secured.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, it is detected as the noncontact IC card itself being about two or more sheets overlapping. By the method which cuts the resonance circuit loop formation with which the noncontact IC card except having been specified is equipped in the sequence set up beforehand [that the circuit scale of a noncontact IC card increases sharply since it is necessary to add a detection means to detect the overlap of noncontact IC cards, and] It is necessary to add the protocol for determining the priority of cutting sequence when the overlap of noncontact IC cards is detected. And even if it adopts such a configuration, the present condition is that whose dependability over overlap detection of noncontact IC cards is not necessarily high.
[0008] An example is taken inconvenient, it is originated, and this invention does not need to detect such a thing that two or more noncontact IC cards overlap, and aims at offer of the non-contact communication media which can moreover perform positive data communication, with a protocol not added, non-contact information read-out / write-in machine, and non-contact communication system.

[Translation done.]

* NOTICES.*

MEANS

[Means for Solving the Problem] The non-contact communication media concerning claim 1 of this invention possess the resonance circuit used for the non-contact communication link with non-contact information read-out / write-in machine. The question signal transmitted from R/W including the user-identification information on the contents that non-contact communication media are specified, The so-called polling command is received, and when the contents of the user-identification information which oneself has memorized, and the contents of the user-identification information included in the received polling command do not agree, it is characterized by being the configuration of cutting one's resonance circuit loop formation. R/W concerning claim 2 is characterized by to be the configuration of performing a non-contact communication link after receiving the reply signal which transmits a polling command including the user-identification information on the contents that non-contact communication media are specified, and is transmitted from the non-contact communication media with which the contents of the user-identification information which oneself has memorized, and the contents of the user-identification information included in the received polling command agreed, and the so-called response.
[0010] The non-contact communication system concerning claim 3 of this invention The resonance circuit used for the non-contact communication link with non-contact information read-out / write-in machine is provided. The polling command transmitted from R/W including the user-identification information on the contents that non-contact communication media are specified is received. The non-contact communication media which cut their resonance circuit loop formation when the contents of the user-identification information which oneself has memorized, and the contents of the user-identification information included in the received polling command do not agree, A polling command including the user-identification information on the contents that non-contact communication media are specified is transmitted. It is characterized by having R/W which performs a non-contact communication link after receiving the response transmitted from the non-contact communication media with which the contents of the user-identification information which oneself has memorized, and the contents of the user-identification information included in the received polling command agreed. The non-contact communication system concerning claim 4 is indicated to claim 3, and it is characterized by containing the category code which limits the candidate for use of non-contact communication media at least in each with the user-identification information which the user-identification information and non-contact communication media of the polling command which R/W transmits have memorized.
[0011] The non-contact communication system concerning claim 5 of this invention is indicated to claim 3, R/W is carried in passage regulation equipment, and it is characterized by including information required for passage authorization at least at each with the user-identification information which the user-identification information and non-contact communication media of the polling command which R/W transmits have memorized. The non-contact communication system concerning claim 6 of this invention is indicated to claim 3, R/W is carried in the automatic ticket gate installed in the station of a railroad, and it is characterized by containing the iron road line code and the section code at each with the user-identification information which the user-identification information and non-contact communication media of the polling command which R/W transmits have memorized.
[0012]
[Embodiment of the Invention] The block diagram which, and is shown, [drawing 1] [the non-contact

communication system concerning the gestalt of this operation] [**] [type] The block diagram which, and is shown, [drawing 2] [R/W which constitutes non-contact communication system] [**] [type] The block diagram which, and is shown, [drawing 3] [the noncontact IC card which is the non-contact communication media which constitute non-contact communication system] [**] [type] The block diagram showing the important section configuration of the noncontact IC card which drawing 4 requires for a modification, and drawing 5 are the sequence diagrams showing the processing actuation performed between R/W and a noncontact IC card, each of R/W and sign 2a and 2b shows a noncontact IC card, and, as for the sign 1 in drawing, the sign 3 shows the field. And the flow chart with which R/W is carried in an automatic ticket gate, and the flow chart and drawing 9 which shows processing actuation of the explanatory view in which drawing 6 shows the example of a configuration of a polling command, the explanatory view in which drawing 7 shows the example of a polling command, and R/W by which drawing 8 was carried in the automatic ticket gate show the fundamental processing actuation at the time of a noncontact IC card being a commuter pass, and drawing 10 are the explanatory views showing the difference in actuation between noncontact IC cards, and drawing 11 is the flow chart the applied processing actuation of the noncontact IC card which is a commuter pass be shown.

[0013] It is used as an automatic wicket system and the non-contact communication system concerning the gestalt of this operation consists of noncontact IC card 2a which is R/W1 which forms the field 3 which serves as a communications area after being carried in the automatic ticket gate installed in the station of a railroad, as drawing 1 shows, two or more commuter passes (drawing two sheets) which communicate with R/W1 after minding a field 3, and 2b. In addition, the number of sheets of noncontact IC card 2a which overlaps mutually, and 2b is not restricted to two sheets, and, of course, you may be three or more sheets. And the antenna coil 4 which R/W1 here carries out an electromagnetic coupling to noncontact IC card 2a and 2b as drawing 2 shows, and carries out data communication to noncontact IC card 2a and 2b, The demodulator circuit 5 which restores to them and takes out the response and data which amplified change of the electrical potential difference generated with antenna coil 4, and have been transmitted from noncontact IC card 2a and 2b, The modulation circuit 6 which superimposes the command and data which are transmitted to noncontact IC card 2a and 2b as change of a field 3, It consists of CPU7 which controls actuation by whole R/W1, RAM9 for storing temporarily the access data of ROM8 and CPU7 with which the control program is stored, and a high order interface 10 connected with high order devices (illustration abbreviation), such as a body of an automatic ticket gate.

[0014] On the other hand, each of noncontact IC card 2a in this case and 2b LC resonance circuit which consists of an LC resonance circuit 11 which electromotive force generates as the electromagnetic induction at the time of the field change accompanying migration in a communications area is also, i.e., a coil, and a capacitor 12 as drawing 3 shows, The power circuit 13 which changes into self operating power the induced electromotive force generated in LC resonance circuit, The demodulator circuit 14 which restores to the command on which the field 3 which R/W1 generates is overlapped, or data, The nonvolatile memory 15 which has memorized various kinds of information, such as the getting-on-and-off section and a shelf-life, CPU16 which controls read-out and the writing from nonvolatile memory 15 according to a command, The modulation circuit 17 to which the current which flows LC resonance circuit is changed in case a response and data are transmitted to R/W1, It consists of a bidirectional switch 18 which functions as a cutting element of a resonance circuit loop formation, and usually sometimes continues carrying out ON actuation, and RAM20 for storing temporarily the access data of ROM19 and CPU16 with which the control program is stored.

[0015] In addition, the ON/OFF control of FET21 is to be an analog switch, i.e., the analog switch which comes to use FET21, as a cutting element not restricted to the bidirectional switch 18 and shown by drawing 4 of course, for FET21 to turn on in the configuration of drawing 4 , especially, until a power source starts, and to be carried out by the switch control signal after it. That is, since the switch control signal outputted from CPU16 until a power source starts is still a low level, a forward electrical potential difference joins the gate of FET21, and it has been turned on. And when a switch control signal is a low level after a power source starts, FET21 turns on, LC resonance circuit will be in the condition which can be operated, when a switch control signal is conversely high-level, FET21 will turn off and LC resonance circuit will be in disabling of operation.

[0016] In R/W1 concerning the gestalt of this operation, a command and data are transmitted to noncontact IC card 2a and 2b according to the directions from a high order device. Processing actuation

which receives the response and data which have been transmitted from noncontact IC card 2a and 2b, and is transmitted to a high order device is performed. Moreover, especially The polling command with which the user-identification information on the contents that noncontact IC card 2a (2b) was specified was included and which it asks and is a signal, For example, carrying out data communication between noncontact IC card 2a while moving in the inside of a communications area, and 2b, after transmitting the polling command as shows the example of a configuration by drawing 6 and receiving the response which are noncontact IC card 2a and a reply signal from 2b is performed. In addition, in the data communication between R/W1 in this case and noncontact IC card 2a, and 2b, general processing actuation as usual, such as mutual recognition for eliminating the anti collision for preventing processing actuation, i.e., interference, as shown by drawing 5 , and a counterfeit card etc., noncontact IC card 2a, and a memory lead and a memory light to the nonvolatile memory 15 of 2b, is performed.

[0017] By the way, although [the gestalt of this operation] non-contact communication system is used as an automatic wicket system, and R/W1 is carried in a station ticket gate machine and noncontact IC card 2a and 2b are commuter passes, as drawing 7 shows, the iron road line code and the station code are contained in the user-identification information on the polling command in such a case at least. In addition, the station code here means the information for pinpointing the station in which the automatic ticket gate which carried R/W1 is installed.

[0018] Moreover, the user-identification information which comes to contain an iron road line code and a section code also in the nonvolatile memory 15 of noncontact IC card 2a in this case and each 2b is memorized beforehand, and the section code here means the information which is the set of the station code which exists within the entrainment section which can be got on and off as the commuter pass which consists of noncontact IC card 2a and 2b is also, and which was specified for every station. Furthermore, CPU16 which each noncontact IC card 2a and 2b possess It is supposed that ON actuation of the bidirectional switch 18 was freely carried out when the contents of the user-identification information beforehand remembered to be the contents of the user-identification information included in the polling command agreed. The iron road line code and station code which are contained in the user-identification information on a polling command when user-identification information does not agree, When it is judged that the iron road line code and section code which are contained in the memorized user-identification information have not agreed, the control which carries out OFF actuation of the bidirectional switch 18 that noncontact IC card 2a and the resonance circuit loop formation of 2b should be cut is to be realized.

[0019] Therefore, the following processing actuation will be performed in noncontact IC card 2a considered as such a configuration, and 2b. First, after the coil 11 received the field 3 which R/W1 has generated and changing that it is also in a power circuit 13 about induced electromotive force into self operating power, it gets over that it is also in a demodulator circuit 14 about the command and data on which the field 3 which R/W1 generates is overlapped. And it will be analyzed that the command and data to which it restored are also at CPU16, and a response is transmitted by changing the current of LC resonance circuit in a modulation circuit 17. Moreover, in this case, noncontact IC card 2b (2a) with which the contents of the user-identification information beforehand remembered to be the contents of the user-identification information included in the polling command did not agree will cut its resonance circuit loop formation, and processing actuation succeedingly shown by drawing 5 is performed henceforth. In addition, although CPU16 is used here, it is also possible to realize that hardware is also about such processing actuation.

[0020] Next, the fundamental processing actuation in the non-contact communication system which consists of R/W1, and two noncontact IC card 2a and 2b is explained based on drawing 8 - drawing 10 . In addition, on the need of changing between two iron road lines, the user possesses noncontact IC card 2a which is two commuter passes, and 2b, and presupposes that iron road line codes differ mutually among the user-identification information beforehand memorized by each noncontact IC card 2a and 2b here.

[0021] First, processing actuation of R/W1 carried in the automatic ticket gate is explained, referring to drawing 8 which is the flow chart which shows processing actuation of R/W. This R/W1 forms the field 3 which serves as a communications area based on the directions from a high order device, is superimposed on a polling command including the user-identification information on the contents that noncontact IC card 2a and 2b are specified by the field 3, and is continuing (S1) being transmitted. And it

is judged whether transmitting a polling command was being continued and the response was received until it receives a response from the user-identification information included in the polling command, i.e., an iron road line code, noncontact IC card 2a, noncontact IC card 2a with which the iron road line code which the 2b itself has memorized as user-identification information agreed, and 2b (S2). Then, when it is judged that the response was received, data communication by processing, such as processing actuation, i.e., anti collision, as shown by drawing 5 between R/W1 which received the response, and noncontact IC card 2a and 2b, mutual recognition, a memory lead, and a memory light, will usually be performed (S3).
[0022] Processing actuation which is explained below is performed, referring to the flow chart of drawing 9 on the other hand, if it is in noncontact IC card 2a which is a commuter pass, and 2b. First, if noncontact IC card 2a which is usually a commuter pass [that the users approaching the automatic ticket gate with which R/W1 was carried have overlapped since the resonance circuit loop formation was formed with ON actuation of noncontact IC card 2a at the time and the bidirectional switch 18 of each 2b carried out], and 2b are shown in the communications area of R/W1, high induced voltage will occur in noncontact IC card 2a and LC resonance circuit of 2b, and a card power source will carry out ON actuation (S1). However, since two noncontact IC card 2a and 2bs overlap and electrical characteristics change, the communications area in this case is narrow compared with the case where noncontact IC card one of 2a (2b) exists independently. And it is judged whether the polling command transmitted from R/W1 was received (S2). In addition, although the communications area is narrow, that a polling command can be received has both these two noncontact IC card 2a and natural 2b.
[0023] furthermore, in noncontact IC card 2a which received the polling command, and 2b [whether the contents of the user-identification information remembered to be the contents of the user-identification information included in the polling command agree, and] That is, decision whether an iron road line code agrees will be performed (S3), and noncontact IC card 2a (2b) with which the iron road line code agreed transmits a response to R/W1, with ON actuation of the bidirectional switch 18 maintained (S4). In noncontact IC card 2b (2a) which did not agree on the other hand since iron road line codes differed, cutting a resonance circuit loop formation is performed by carrying out OFF actuation of the bidirectional switch 18 (S5). That is, each of noncontact IC card 2a and 2b will perform actuation as shown by drawing 10 in this case. Consequently, although two noncontact IC card 2a and 2bs overlap, since the resonance circuit loop formation of noncontact IC card 2b (2a) is cut, each noncontact IC card 2a and 2b will be in the condition same with existing independently.
[0024] Consequently, it does not happen that coil 11 comrades which constitute each noncontact IC card 2a and LC resonance circuit of 2b carry out an electromagnetic coupling, but it becomes, without a mutual inductance occurring among these coils 11. therefore, the case where, as for overlapping noncontact IC card 2a and the resonance point to R/W1 of 2b, each noncontact IC card 2a and 2b exist independently and abbreviation -- it will be the same, and between these noncontact IC card 2a, 2b, and R/W1, no un-arranging also has data communication and activation of it is attained. So, between R/W1 which received the response, and noncontact IC card 2a and 2b, data communication by processing, such as mutual recognition, a memory lead, and a memory light, is usually performed (S6). In addition, when a polling command is not received by which noncontact IC card 2a and 2b, either, both noncontact IC card 2a after it will be judged whether the synchronous timing of a polling command and corresponding fixed time amount passed (S7) and fixed time amount passes, and 2b will carry out OFF actuation of the bidirectional switch 18, and will cut a resonance circuit loop formation (S5).
[0025] Furthermore, noncontact IC card 2a which is a commuter pass, and applied processing actuation of 2b are explained, referring to the flow chart shown by drawing 11 succeedingly. In addition, since processing actuation of R/W1 carried in the automatic ticket gate is the same as the contents explained with reference to drawing 8 , it omits explanation. And on the need of using the route where the entrainment section was divided into two although it was a single iron road line here, The user possesses two noncontact IC card 2a and 2b as a commuter pass. It is premised on the division code which shows that these noncontact IC card 2a and 2b use a division route, and the section code being memorized as user-identification information while noncontact IC card 2a and an iron road line code common to each of 2b as user-identification information are memorized.
[0026] If noncontact IC card [that users have overlapped] 2a and 2b are shown in the communications area of R/W1, ON actuation of each noncontact IC card 2a and the card power source of 2b will be carried out (S1), and it will be judged whether the polling command was received (S2). And it is judged

whether whether the contents of the user-identification information remembered to be the contents of the user-identification information which the user-identification information included in the polling command will be read as noncontact IC card 2a and 2b be alike, respectively, and was read agreeing, and an iron road line code that is, have agreed (S3). Here, when an iron road line code does not agree, which noncontact IC card 2a and 2b will also carry out OFF actuation of the bidirectional switch 18, and will cut a resonance circuit loop formation, and (S4) and processing actuation end them. Moreover, if the existence of a division code will be judged after reading the division code of the user-identification information (S5) and there is no division code when the iron road line code has agreed, after transmitting a response (S6), data communication by processing will usually be performed between R/W1 (S7).

[0027] on the other hand, when judged as those with a division code, the section code memorized by the station code contained in the polling command, noncontact IC card 2a, and 2b is read succeedingly -- ******** (S8) -- a station code -- noncontact IC card 2a and 2b -- (S9) it is judged to be whether it is contained in which section code. And when noncontact IC card 2b at the time of it being judged that the station code is contained in the section code of noncontact IC card 2a carries out OFF actuation of the bidirectional switch 18, a resonance circuit loop formation will be cut (S10), and noncontact IC card 2a transmits a response to R/W1, with ON actuation of the bidirectional switch 18 maintained (S11). Moreover, if the station code is contained in the section code read in noncontact IC card 2b, when noncontact IC card 2a carries out OFF actuation of the bidirectional switch 18, a resonance circuit loop formation will be cut (S10), and noncontact IC card 2b will transmit a response to R/W1, with ON actuation of the bidirectional switch 18 maintained (S11). Then, between R/W1 and noncontact IC card 2a, and 2b, data communication by processing, such as anti collision, mutual recognition, a memory lead, and a memory light, is usually performed (S12).

[0028] By the way, in the gestalt of this operation, although the non-contact communication system with which R/W1 is carried in a station ticket gate machine, and noncontact IC card 2a and 2b are a commuter pass, a ticket, etc., and consist of R/W1 and noncontact IC card 2a, and 2b is used as an automatic wicket system, use in the example of an application as not limited only to such a configuration, for example, shown below is also possible. Namely, although illustration is omitted It is carried in the passage regulation equipment with which R/W was installed in the high-speed toll gate, the pay parking lot, etc. Noncontact IC cards may be a highway traffic ticket and a parking ticket. under the present circumstances, the user-identification information which the user-identification information and the noncontact IC card of the polling command which R/W which can be boiled and set transmits have memorized -- it is alike, respectively and information required for passage authorization at least is included, if it becomes Even if it is the case where two or more noncontact IC cards overlapped, and are shown, positive data communication can be performed.

[0029] Moreover, there is not necessarily necessity that the non-contact communication system concerning the gestalt of this operation is used only in an intersection customs clearance staff. As opposed to each with the user-identification information which the user-identification information and the noncontact IC card of the polling command which R/W transmits have memorized When it is also possible to include the category code which limits the candidate for use of a noncontact IC card, such as an object for close leaving and an object for cash drawers, and such a configuration is adopted Even if the noncontact IC card which is a commuter pass, and the noncontact IC card which is an object for close leaving are shown in the condition of having overlapped mutually, it will be distinguished easily, and proper processing actuation will be performed corresponding to an application. That is, it becomes possible to use non-contact communication system as various kinds of security systems by what the application of the non-contact communication system explained above is not limited only to an intersection customs clearance staff, the noncontact IC card is done to registration, such as a password and an ID code, and it does for R/W to check control, such as a password and an ID code. Of course, it may be included in accessories, such as a wrist watch which non-contact communication media were not limited to a noncontact IC card, for example, the user has attached to the body further again.

[Translation done.]

* NOTICES.*

DESCRIPTION OF DRAWINGS

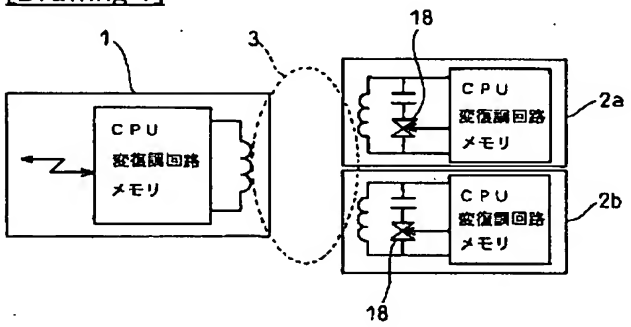
[Brief Description of the Drawings]
[Drawing 1] It is the block diagram in which, and showing it. [the non-contact communication system concerning the gestalt of this operation] [**] [type]
[Drawing 2] It is the block diagram in which, and showing it. [R/W which constitutes non-contact communication system] [**] [type]
[Drawing 3] It is the block diagram in which, and showing it. [the noncontact IC card which is the non-contact communication media which constitute non-contact communication system] [**] [type]
[Drawing 4] It is the block diagram showing the important section configuration of the noncontact IC card concerning a modification.
[Drawing 5] It is the sequence diagram showing the processing actuation performed between R/W and a noncontact IC card.
[Drawing 6] It is the explanatory view showing the example of a configuration of a polling command.
[Drawing 7] It is the explanatory view showing the example of a polling command.
[Drawing 8] It is the flow chart which shows processing actuation of R/W carried in the automatic ticket gate.
[Drawing 9] It is the flow chart which R/W is carried in an automatic ticket gate, and shows the fundamental processing actuation at the time of a noncontact IC card being a commuter pass.
[Drawing 10] It is the explanatory view showing the difference in actuation between noncontact IC cards.

[Drawing 11] It is the flow chart which shows applied processing actuation of the noncontact IC card which is a commuter pass.
[Description of Notations]
1 R/W (Non-contact Information Read-out / Write-in Machine)
2a Noncontact IC card (non-contact communication media)
2b Noncontact IC card (non-contact communication media)

[Translation done.]

DRAWINGS

[Drawing 1]



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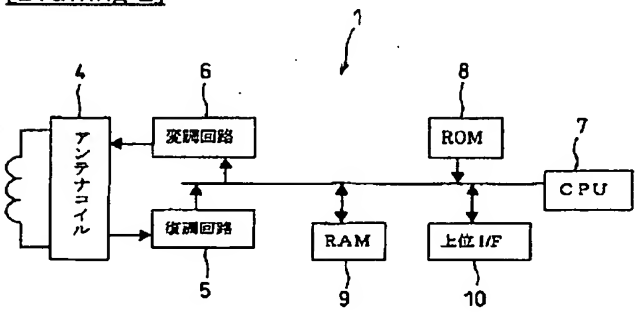

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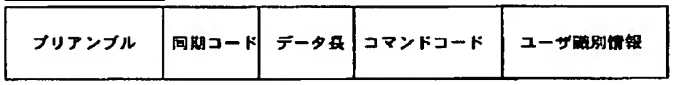

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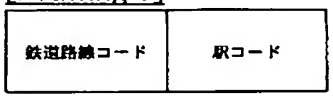

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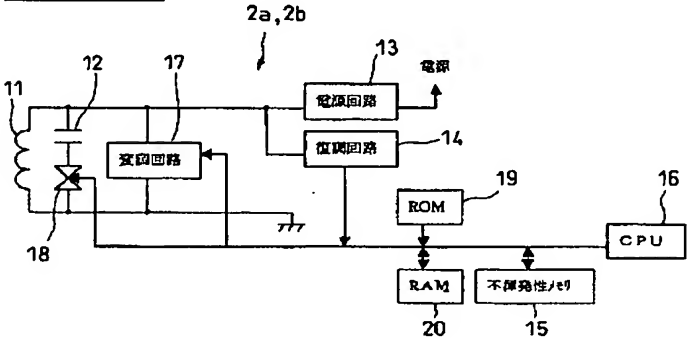

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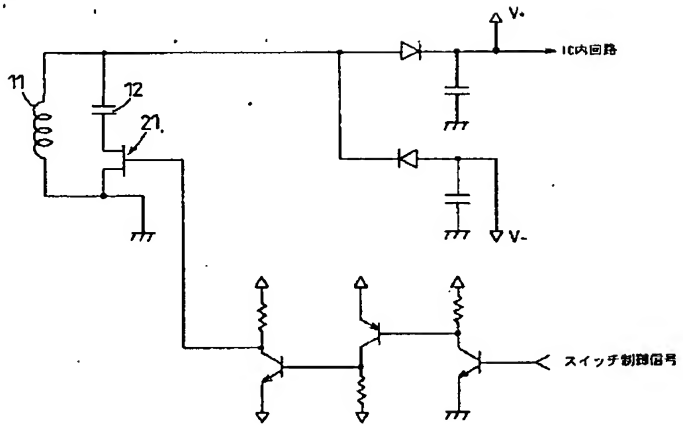

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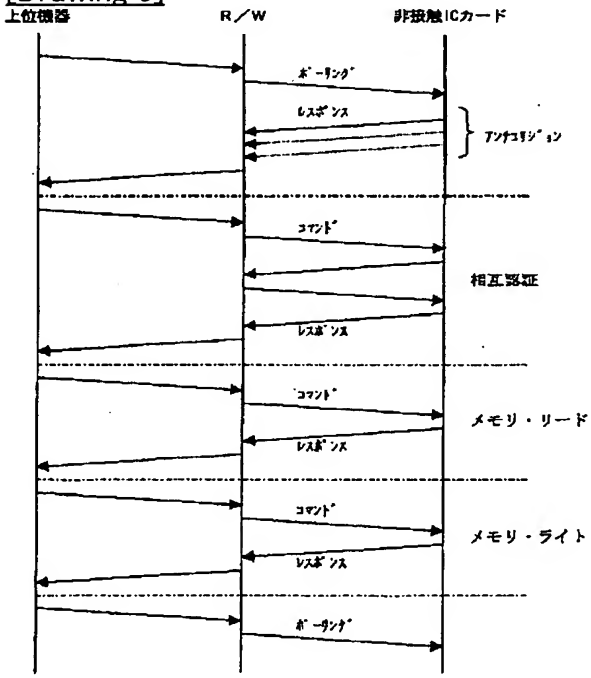

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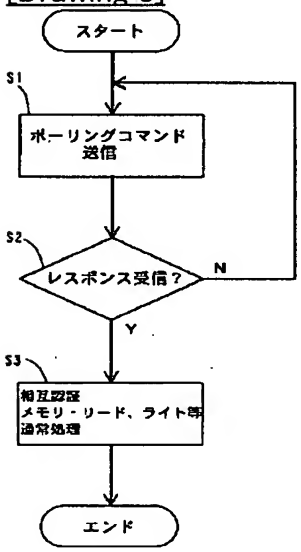

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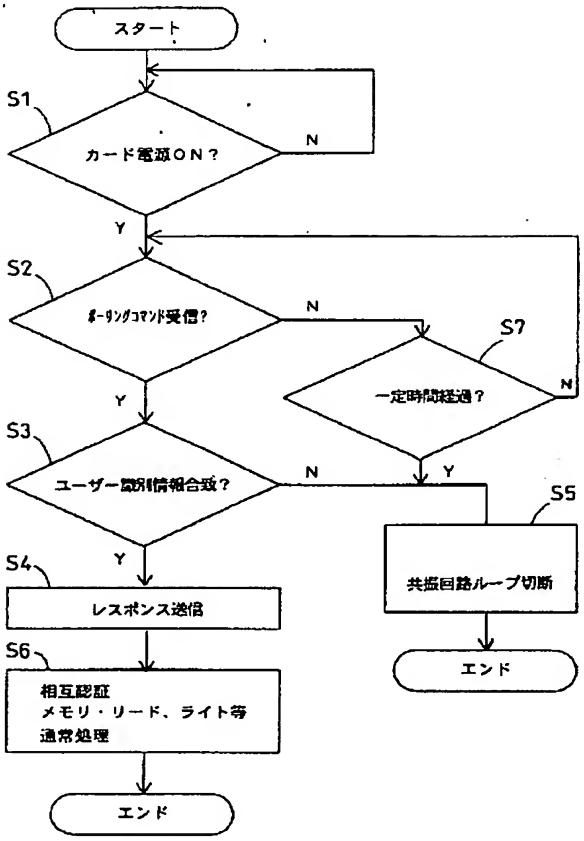

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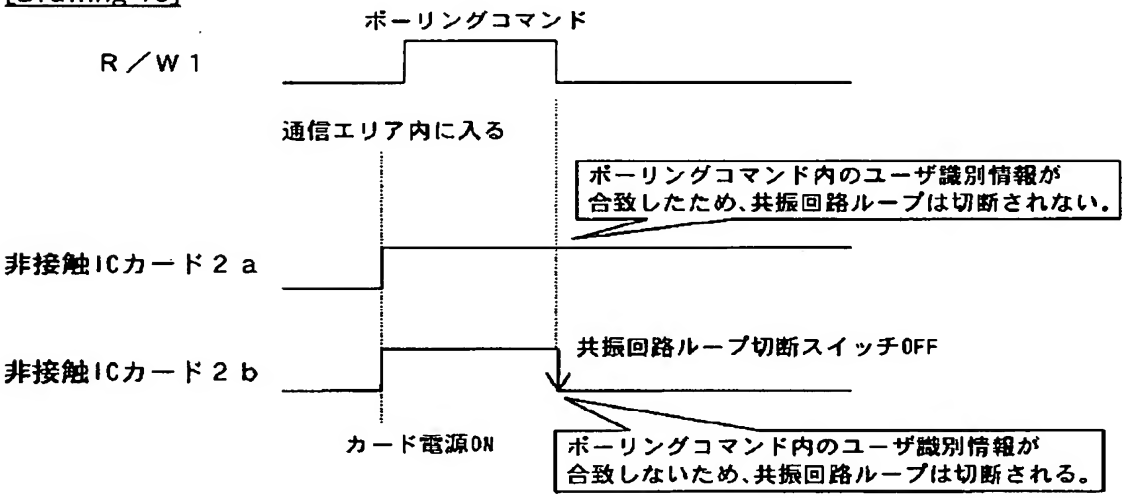

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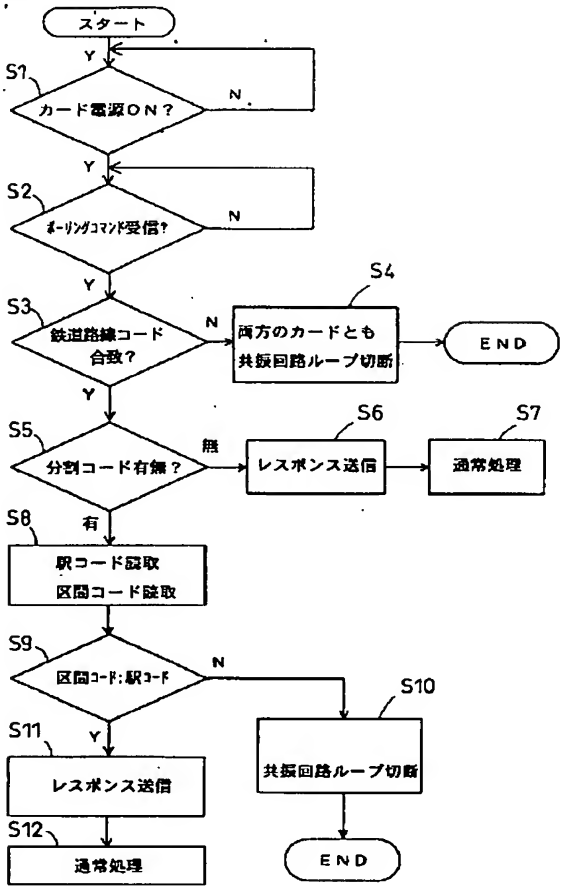

[Translation done.]

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Ｇ０７Ｂ	11/00	５０１	Ｇ０７Ｂ	11/00	５０１	５Ｋ０１２
	15/00	５０１		15/00	５０１	
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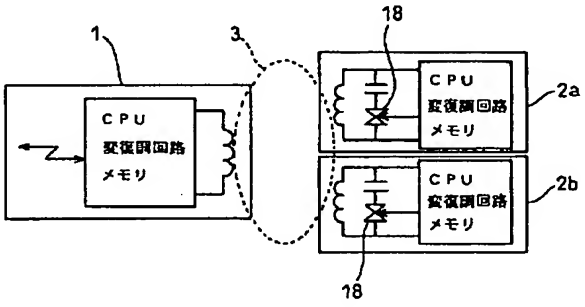
最終頁に続く

(54)【発明の名称】　非接触通信媒体、非接触情報読出／書込機及び非接触通信システム

(57)【要約】
【課題】非接触ＩＣカードが重なり合っていることを検知する必要がなく、しかも、プロトコルを追加する必要もないままでの確実なデータ通信が実行可能な非接触通信媒体、非接触情報読出／書込機及び非接触通信システムを提供する。
【解決手段】本発明に係る非接触通信システムは、非接触通信媒体２ａ，２ｂを特定するユーザ識別情報を含んで送信されてくる問いかけ信号を受信し、記憶しているユーザ識別情報と受信した問いかけ信号に含まれるユーザ識別情報とが合致しなかった際には自らの共振回路ループを切断する非接触通信媒体２ａ，２ｂと、非接触通信媒体２ａ，２ｂを特定するユーザ識別情報を含んだ問いかけ信号を送信し、記憶しているユーザ識別情報と受信した問いかけ信号に含まれるユーザ識別情報とが合致した非接触通信媒体２ａ，２ｂから送信されてくる応答信号を受信して非接触通信を実行する非接触情報読出／書込機１とを備えている。



1

【特許請求の範囲】

【請求項１】　非接触情報読出／書込機との非接触通信に用いられる共振回路を具備しており、非接触通信媒体を特定する内容のユーザ識別情報を含んで非接触情報読出／書込機から送信されてくる問いかけ信号を受信し、自らが記憶しているユーザ識別情報の内容と受信した問いかけ信号に含まれるユーザ識別情報の内容とが合致しなかった際には自らの共振回路ループを切断する構成であることを特徴とする非接触通信媒体。

【請求項２】　非接触通信媒体を特定する内容のユーザ識別情報を含んだ問いかけ信号を送信し、自らが記憶しているユーザ識別情報の内容と受信した問いかけ信号に含まれるユーザ識別情報の内容とが合致した非接触通信媒体から送信されてくる応答信号を受信したうえで非接触通信を実行する構成であることを特徴とする非接触情報読出／書込機。

【請求項３】　非接触情報読出／書込機との非接触通信に用いられる共振回路を具備しており、非接触通信媒体を特定する内容のユーザ識別情報を含んで非接触情報読出／書込機から送信されてくる問いかけ信号を受信し、自らが記憶しているユーザ識別情報の内容と受信した問いかけ信号に含まれるユーザ識別情報の内容とが合致しなかった際には自らの共振回路ループを切断する非接触通信媒体と、

非接触通信媒体を特定する内容のユーザ識別情報を含んだ問いかけ信号を送信し、自らが記憶しているユーザ識別情報の内容と受信した問いかけ信号に含まれるユーザ識別情報の内容とが合致した非接触通信媒体から送信されてくる応答信号を受信したうえで非接触通信を実行する非接触情報読出／書込機とを備えていることを特徴とする非接触通信システム。

【請求項４】　請求項３に記載した非接触通信システムであって、

非接触情報読出／書込機が送信する問いかけ信号のユーザ識別情報と非接触通信媒体が記憶しているユーザ識別情報とのそれぞれには、少なくとも非接触通信媒体の使用対象を限定するカテゴリーコードが含まれていることを特徴とする非接触通信システム。

【請求項５】　請求項３に記載した非接触通信システムであって、

非接触情報読出／書込機は通過規制装置に搭載されたものであり、非接触情報読出／書込機が送信する問いかけ信号のユーザ識別情報と非接触通信媒体が記憶しているユーザ識別情報とのそれぞれには、少なくとも通過許可に必要な情報が含まれていることを特徴とする非接触通信システム。

【請求項６】　請求項３に記載した非接触通信システムであって、

非接触情報読出／書込機は自動改札機に搭載されたものであり、非接触情報読出／書込機が送信する問いかけ信号のユーザ識別情報と非接触通信媒体が記憶しているユーザ識別情報とのそれぞれには、鉄道路線コード及び区間コードが含まれていることを特徴とする非接触通信システム。

2

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、非接触通信媒体、非接触情報読出／書込機及び非接触通信システムに関する。

【０００２】

【従来の技術】従来から、例えば、鉄道の駅では定期券や乗車券として磁気カードを利用する自動改札システムが導入されているが、この種の自動改札システムでは、鉄道の駅に設置された自動改札機を通過する度毎に利用者がカードホルダである定期券入れや財布から定期券を取り出したうえで自動改札機に投入し、かつ、定期券を回収して定期券入れに収納する必要があるため、煩わしい手間を要してしまう。そこで、近年においては、利用者が定期券を自動改札機に提示するだけのことによって通行可能な非接触式の自動改札システムが実用化されつつあり、図示省略しているが、この種の自動改札システムでは、磁界を発生するアンテナコイルが設けられた非接触情報読出／書込機、いわゆるリーダ／ライタ（以下、Ｒ／Ｗという）を搭載してなる自動改札機と、Ｒ／Ｗが発する磁界からなる通信エリア内を通過しながらＲ／Ｗとの間でデータ通信を行うことによって改札処理を実行させる非接触通信媒体、例えば、非接触ＩＣカードである定期券や乗車券が使用されている。

【０００３】すなわち、定期券などとして用いられる非接触ＩＣカードは、Ｒ／Ｗが発する磁界による電磁誘導でもって共振動作し、共振動作に伴って起電力を発生するＬＣ共振回路、つまり、コイル及びコンデンサからなるＬＣ共振回路とともに、誘導起電力を自己の動作電力に変換する電源回路、Ｒ／Ｗが発生する磁界に重畳されているコマンドやデータを復調する復調回路、コマンドに従ってデータをメモリ内に書き込んだりメモリ内のデータを読み出したりする制御手段であるＣＰＵなどを備えて構成されたものであり、これらの非接触ＩＣカードとＲ／Ｗとの間で通信されるデータは乗車区間や使用可能期間、入出札記録などのような情報であることになっている。

【０００４】ところで、複数の鉄道路線間を乗り継いだり、単一の鉄道路線であっても乗車区間が分割された路線を利用したりする利用者は、複数枚の非接触ＩＣカードを定期券として所持する必要があるが、複数枚の非接触ＩＣカードを重ね合わせたままで定期券入れや財布などのカードホルダに収納しておき、カードホルダに収納した複数枚の非接触ＩＣカードをそのまま提示することによって自動改札機を通過できれば、利用者にとっては手間を要することがなくて誠に好都合となる。

【０００５】しかしながら、例えば、２枚の非接触ＩＣカードが重なり合っている際には、非接触ＩＣカード同士がR／Wの磁界内で近接配置されているため、それぞれのＬＣ共振回路を構成しているコイルＬ１，Ｌ２同士が電磁結合し、これらのコイルＬ１，Ｌ２間に相互インダクタンスMが発生する結果、R／Wに対する非接触ＩＣカードの共振点ω_0'が単独の非接触ＩＣカードである場合の共振点ω_0とは異なることになってしまう。すなわち、ＬＣ共振回路のそれぞれを構成しているコンデンサがＣ１，Ｃ２であり、かつ、Ｌ１＝Ｌ２＝Ｌ，Ｃ１＝Ｃ２＝Ｃであるならば、非接触ＩＣカードが単独で存在している際の共振点ω_0は$\omega_0=1/(L\times C)^{1/2}$であるの対し、重なり合っている場合の共振点$\omega_0'$は$\omega_0'=1/((L+M)\times C)^{1/2}$となる。そのため、R／Wへの返信時には各非接触ＩＣカードのＬＣ共振回路を流れる電流の変化が少なくなり、R／Wの受信信号レベルが小さくなる結果、これらの非接触ＩＣカードとR／Wとの間でデータ通信を行うことができなくなる。

【０００６】このような不都合を避ける必要上、複数枚が重なり合っていることを非接触ＩＣカード自身でもって検知し、特定された以外の非接触ＩＣカードが備えている共振回路ループを予め設定された順序で切断することによってコイル同士の電磁結合をなくす方式が提案されている。すなわち、図示省略しているが、非接触ＩＣカードそれぞれの共振回路ループ中に双方向スイッチやＦＥＴ回路などのような切断要素を予め組み込んでおき、特定された以外の非接触ＩＣカードが備えている共振回路ループを切断要素でもって切断してしまう方式である。そして、このような方式であれば、特定された以外の非接触ＩＣカードにおける共振回路ループが切断されてしまうため、ＬＣ共振回路を構成しているコイル同士間に相互インダクタンスが発生することは起こらず、非接触ＩＣカードそれぞれの共振点ω_0'がω_0と等しくなる結果としてデータ通信が可能であることになる。

【０００７】

【発明が解決しようとする課題】ところが、複数枚が重なり合っていることを非接触ＩＣカード自身でもって検知し、特定された以外の非接触ＩＣカードが備えている共振回路ループを予め設定された順序で切断する方式では、非接触ＩＣカード同士の重なり合いを検知する検知手段を付加しておく必要があるために非接触ＩＣカードの回路規模が大幅に増加するばかりか、非接触ＩＣカード同士の重なり合いが検知された場合における切断順序の優先順位を決定するためのプロトコルを追加しておくことが必要となる。そして、このような構成を採用したとしても、非接触ＩＣカード同士の重なり合い検知に対する信頼性は必ずしも高くないのが現状である。

【０００８】本発明は、このような不都合に鑑みて創案されたものであり、複数枚の非接触ＩＣカードが重なり合っていることを検知する必要がなく、しかも、プロトコルを追加する必要もないままでの確実なデータ通信が実行可能な非接触通信媒体、非接触情報読出／書込機及び非接触通信システムの提供を目的としている。

【０００９】

【課題を解決するための手段】本発明の請求項１に係る非接触通信媒体は、非接触情報読出／書込機との非接触通信に用いられる共振回路を具備しており、非接触通信媒体を特定する内容のユーザ識別情報を含んでR／Wから送信されてくる問いかけ信号、いわゆるポーリングコマンドを受信し、自らが記憶しているユーザ識別情報の内容と受信したポーリングコマンドに含まれるユーザ識別情報の内容とが合致しなかった際には自らの共振回路ループを切断する構成であることを特徴とする。請求項２に係るR／Wは、非接触通信媒体を特定する内容のユーザ識別情報を含んだポーリングコマンドを送信し、自らが記憶しているユーザ識別情報の内容と受信したポーリングコマンドに含まれるユーザ識別情報の内容とが合致した非接触通信媒体から送信されてくる応答信号、いわゆるレスポンスを受信したうえで非接触通信を実行する構成であることを特徴としている。

【００１０】本発明の請求項３に係る非接触通信システムは、非接触情報読出／書込機との非接触通信に用いられる共振回路を具備しており、非接触通信媒体を特定する内容のユーザ識別情報を含んでR／Wから送信されてくるポーリングコマンドを受信し、自らが記憶しているユーザ識別情報の内容と受信したポーリングコマンドに含まれるユーザ識別情報の内容とが合致しなかった際には自らの共振回路ループを切断する非接触通信媒体と、非接触通信媒体を特定する内容のユーザ識別情報を含んだポーリングコマンドを送信し、自らが記憶しているユーザ識別情報の内容と受信したポーリングコマンドに含まれるユーザ識別情報の内容とが合致した非接触通信媒体から送信されてくるレスポンスを受信したうえで非接触通信を実行するR／Wとを備えていることを特徴とする。請求項４に係る非接触通信システムは請求項３に記載したものであって、R／Wが送信するポーリングコマンドのユーザ識別情報と非接触通信媒体が記憶しているユーザ識別情報とのそれぞれには、少なくとも非接触通信媒体の使用対象を限定するカテゴリーコードが含まれていることを特徴とする。

【００１１】本発明の請求項５に係る非接触通信システムは請求項３に記載したものであって、R／Wは通過規制装置に搭載されたものであり、R／Wが送信するポーリングコマンドのユーザ識別情報と非接触通信媒体が記憶しているユーザ識別情報とのそれぞれには、少なくとも通過許可に必要な情報が含まれていることを特徴とする。本発明の請求項６に係る非接触通信システムは請求項３に記載したものであって、R／Wは鉄道の駅に設置された自動改札機に搭載されたものであり、R／Wが送信するポーリングコマンドのユーザ識別情報と非接触通

信媒体が記憶しているユーザ識別情報とのそれぞれには、鉄道路線コード及び区間コードが含まれていることを特徴とする。

【００１２】

【発明の実施の形態】図１は本実施の形態に係る非接触通信システムを模式化して示すブロック図、図２は非接触通信システムを構成するＲ／Ｗを模式化して示すブロック図、図３は非接触通信システムを構成する非接触通信媒体である非接触ＩＣカードを模式化して示すブロック図、図４は変形例に係る非接触ＩＣカードの要部構成を示すブロック図、図５はＲ／Ｗと非接触ＩＣカードとの間で実行される処理動作を示すシーケンス図であり、図中の符号１はＲ／Ｗ、符号２ａ，２ｂのそれぞれは非接触ＩＣカード、符号３は磁界を示している。そして、図６はポーリングコマンドの構成例を示す説明図、図７はポーリングコマンドの具体例を示す説明図、図８は自動改札機に搭載されたＲ／Ｗの処理動作を示すフローチャート、図９はＲ／Ｗが自動改札機に搭載され、かつ、非接触ＩＣカードが定期券である際の基本的な処理動作を示すフローチャート、図１０は非接触ＩＣカード相互の動作の違いを示す説明図であり、図１１は定期券である非接触ＩＣカードの応用的な処理動作を示すフローチャートである。

【００１３】本実施の形態に係る非接触通信システムは、例えば、自動改札システムとして利用されるものであり、図１で示すように、鉄道の駅に設置された自動改札機に搭載されたうえで通信エリアとなる磁界３を形成するＲ／Ｗ１と、磁界３を介したうえでＲ／Ｗ１と交信する複数枚（図では、２枚）の定期券などである非接触ＩＣカード２ａ，２ｂとから構成されている。なお、互いに重なり合っている非接触ＩＣカード２ａ，２ｂの枚数が２枚に限られることはなく、３枚以上であってもよいことは勿論である。そして、ここでのＲ／Ｗ１は、図２で示すように、非接触ＩＣカード２ａ，２ｂと電磁結合し、非接触ＩＣカード２ａ，２ｂとデータ通信するアンテナコイル４と、アンテナコイル４で発生した電圧の変化を増幅し、非接触ＩＣカード２ａ，２ｂから送信されてきたレスポンス及びデータを復調して取り出す復調回路５と、非接触ＩＣカード２ａ，２ｂへと送信されるコマンド及びデータを磁界３の変化として重畳する変調回路６と、Ｒ／Ｗ１の全体動作を制御するＣＰＵ７と、制御プログラムが格納されているＲＯＭ８と、ＣＰＵ７のアクセスデータを一時記憶しておくためのＲＡＭ９と、自動改札機本体などの上位機器（図示省略）と接続された上位インターフェイス１０とから構成されている。

【００１４】一方、この際における非接触ＩＣカード２ａ，２ｂの各々は、図３で示すように、通信エリア内での移動に伴う磁界変化時の電磁誘導でもって起電力が発生するＬＣ共振回路、つまり、コイル１１及びコンデンサ１２からなるＬＣ共振回路と、ＬＣ共振回路で発生した誘導起電力を自己の動作電力に変換する電源回路１３と、Ｒ／Ｗ１が発生する磁界３に重畳されているコマンドやデータを復調する復調回路１４と、乗降区間や有効期間などのような各種の情報を記憶している不揮発性メモリ１５と、コマンドに従って不揮発性メモリ１５からの読み出しや書き込みを制御するＣＰＵ１６と、レスポンス及びデータをＲ／Ｗ１へと送信する際にＬＣ共振回路を流れる電流を変化させる変調回路１７と、共振回路ループの切断要素として機能し、かつ、通常時にはＯＮ動作し続ける双方向スイッチ１８と、制御プログラムが格納されているＲＯＭ１９と、ＣＰＵ１６のアクセスデータを一時記憶するためのＲＡＭ２０とから構成されている。

【００１５】なお、切断要素が双方向スイッチ１８に限られることはなく、図４で示すようなアナログスイッチ、つまり、ＦＥＴ２１を用いてなるアナログスイッチであってもよいことは勿論であり、特に、図４の構成においては、電源が立ち上がるまではＦＥＴ２１がＯＮし、それ以降はスイッチ制御信号によってＦＥＴ２１がＯＮ／ＯＦＦ制御されることになっている。すなわち、電源が立ち上がるまでのＣＰＵ１６から出力されるスイッチ制御信号はローレベルのままであるので、ＦＥＴ２１のゲートには正電圧が加わってＯＮになっている。そして、電源が立ち上がった後にスイッチ制御信号がローレベルの時にはＦＥＴ２１がＯＮしてＬＣ共振回路が動作可能状態となり、逆にスイッチ制御信号がハイレベルの時にはＦＥＴ２１がＯＦＦしてＬＣ共振回路が動作不能状態となる。

【００１６】本実施の形態に係るＲ／Ｗ１では、上位機器からの指示に従って非接触ＩＣカード２ａ，２ｂへとコマンド及びデータを送信し、また、非接触ＩＣカード２ａ，２ｂから送信されてきたレスポンス及びデータを受信して上位機器へと伝送する処理動作が実行されており、特には、非接触ＩＣカード２ａ（２ｂ）を特定する内容のユーザ識別情報が含まれた問いかけ信号であるポーリングコマンド、例えば、図６で構成例を示すようなポーリングコマンドを送信し、非接触ＩＣカード２ａ，２ｂからの応答信号であるレスポンスを受信したうえで通信エリア内を移動中の非接触ＩＣカード２ａ，２ｂとの間でデータ通信することが行われる。なお、この際におけるＲ／Ｗ１及び非接触ＩＣカード２ａ，２ｂ間のデータ通信では、図５で示すような処理動作、つまり、混信を防止するためのアンチコリジョン、偽造カードを排除するためなどの相互認証、非接触ＩＣカード２ａ，２ｂの不揮発性メモリ１５に対するメモリリードやメモリライトといった従来通りの一般的な処理動作が実行される。

【００１７】ところで、本実施の形態では、非接触通信システムが自動改札システムとして利用されるものであ

り、Ｒ／Ｗ１が駅改札機に搭載され、かつ、非接触ＩＣカード２ａ，２ｂが定期券であるとしているが、このような場合におけるポーリングコマンドのユーザ識別情報には、図７で示すように、少なくとも鉄道路線コード及び駅コードが含まれている。なお、ここでの駅コードは、Ｒ／Ｗ１を搭載した自動改札機が設置されている駅を特定するための情報を意味している。

【００１８】また、この際における非接触ＩＣカード２ａ，２ｂそれぞれの不揮発性メモリ１５にも、鉄道路線コード及び区間コードを含んでなるユーザ識別情報が予め記憶されており、ここでの区間コードは、非接触ＩＣカード２ａ，２ｂからなる定期券でもって乗降可能な乗車区間内に存在している駅毎に特定された駅コードの集合である情報を意味している。さらに、各非接触ＩＣカード２ａ，２ｂが具備しているＣＰＵ１６は、ポーリングコマンドに含まれたユーザ識別情報の内容と予め記憶しているユーザ識別情報の内容とが合致した際には双方向スイッチ１８をＯＮ動作させたままとし、ユーザ識別情報が合致しなかった際、例えば、ポーリングコマンドのユーザ識別情報に含まれる鉄道路線コードや駅コードと、記憶しているユーザ識別情報に含まれる鉄道路線コード及び区間コードとが合致していないと判断した場合には、非接触ＩＣカード２ａ，２ｂの共振回路ループを切断すべく双方向スイッチ１８をＯＦＦ動作させる制御を実現することになっている。

【００１９】従って、このような構成とされた非接触ＩＣカード２ａ，２ｂにおいては、以下のような処理動作が行われることになる。まず、Ｒ／Ｗ１が発生している磁界３をコイル１１で受信し、誘導起電力を電源回路１３でもって自己の動作電力に変換したうえ、Ｒ／Ｗ１が発生する磁界３に重畳されているコマンド及びデータを復調回路１４でもって復調する。そして、復調されたコマンド及びデータはＣＰＵ１６でもって解析されることになり、変調回路１７でＬＣ共振回路の電流を変化させることによってレスポンスが送信される。また、この際、ポーリングコマンドに含まれたユーザ識別情報の内容と予め記憶しているユーザ識別情報の内容とが合致しなかった非接触ＩＣカード２ｂ（２ａ）は自らの共振回路ループを切断することになり、以後、引き続いて図５で示した処理動作が実行される。なお、ここではＣＰＵ１６を用いているが、このような処理動作をハードウェアでもって実現することも可能である。

【００２０】次に、Ｒ／Ｗ１と２枚の非接触ＩＣカード２ａ，２ｂとから構成される非接触通信システムにおける基本的な処理動作を、図８～図１０に基づいて説明する。なお、ここでは、２つの鉄道路線間を乗り継ぐ必要上、利用者が２枚の定期券である非接触ＩＣカード２ａ，２ｂを所持しており、各非接触ＩＣカード２ａ，２ｂに予め記憶されているユーザ識別情報のうち、鉄道路線コードが互いに異なっているとする。

【００２１】まず、Ｒ／Ｗの処理動作を示すフローチャートである図８を参照しながら、自動改札機に搭載されたＲ／Ｗ１の処理動作を説明する。このＲ／Ｗ１は上位機器からの指示に基づいて通信エリアとなる磁界３を形成しており、非接触ＩＣカード２ａ，２ｂを特定する内容のユーザ識別情報を含んだポーリングコマンドが磁界３に重畳されて送信され続けている（Ｓ１）。そして、ポーリングコマンドに含まれたユーザ識別情報、つまり、鉄道路線コードと非接触ＩＣカード２ａ，２ｂ自らがユーザ識別情報として記憶している鉄道路線コードとが合致した非接触ＩＣカード２ａ，２ｂからレスポンスを受信するまでポーリングコマンドを送信し続けており、レスポンスを受信したか否かが判断される（Ｓ２）。その後、レスポンスを受信したと判断されると、レスポンスを受信したＲ／Ｗ１と非接触ＩＣカード２ａ，２ｂとの間においては、図５で示したような処理動作、すなわち、アンチコリジョン、相互認証、メモリリード、メモリライトといった通常処理によるデータ通信が実行されることになる（Ｓ３）。

【００２２】一方、定期券である非接触ＩＣカード２ａ，２ｂにあっては、図９のフローチャートを参照しながら、以下に説明するような処理動作が実行される。まず、通常時における非接触ＩＣカード２ａ，２ｂそれぞれの双方向スイッチ１８はＯＮ動作したままで共振回路ループを成立させているので、Ｒ／Ｗ１が搭載された自動改札機へと近づいた利用者が重なり合ったままの定期券である非接触ＩＣカード２ａ，２ｂをＲ／Ｗ１の通信エリア内で提示すると、非接触ＩＣカード２ａ，２ｂのＬＣ共振回路には高い誘起電圧が発生し、カード電源はＯＮ動作する（Ｓ１）。ただし、この際における通信エリアは、２枚の非接触ＩＣカード２ａ，２ｂが重なり合って電気的特性が変化するため、いずれか一方の非接触ＩＣカード２ａ（２ｂ）のみが単独で存在している場合に比べて狭くなっている。そして、Ｒ／Ｗ１から送信されているポーリングコマンドを受信したか否かが判断される（Ｓ２）。なお、通信エリアは狭くなっているが、これら２枚の非接触ＩＣカード２ａ，２ｂがともにポーリングコマンドを受信し得ることは勿論である。

【００２３】さらに、ポーリングコマンドを受信した非接触ＩＣカード２ａ，２ｂでは、ポーリングコマンドに含まれたユーザ識別情報の内容と記憶しているユーザ識別情報の内容とが合致するか否か、つまり、鉄道路線コードが合致するか否かの判断が実行されることになり（Ｓ３）、鉄道路線コードが合致した非接触ＩＣカード２ａ（２ｂ）は双方向スイッチ１８のＯＮ動作を維持したままでＲ／Ｗ１に対してレスポンスを送信する（Ｓ４）。一方、鉄道路線コードが異なるために合致しなかった非接触ＩＣカード２ｂ（２ａ）では、双方向スイッチ１８をＯＦＦ動作させることによって共振回路ループを切断することが実行される（Ｓ５）。すなわち、この

際、非接触ＩＣカード２ａ，２ｂの各々は、図１０で示すような動作を実行することになる。その結果、２枚の非接触ＩＣカード２ａ，２ｂが重なり合っているにも拘わらず、非接触ＩＣカード２ｂ（２ａ）の共振回路ループが切断されているから、各々の非接触ＩＣカード２ａ，２ｂは単独で存在しているのと同様の状態となる。

【００２４】その結果、各非接触ＩＣカード２ａ，２ｂのＬＣ共振回路を構成しているコイル１１同士が電磁結合することは起こらず、これらのコイル１１間で相互インダクタンスが発生することもなくなる。従って、重なり合った非接触ＩＣカード２ａ，２ｂのＲ／Ｗ１に対する共振点は各非接触ＩＣカード２ａ，２ｂが単独で存在している場合と略同一であることになり、これらの非接触ＩＣカード２ａ，２ｂとＲ／Ｗ１との間ではデータ通信が何らの不都合もなく実行可能となる。そこで、レスポンスを受信したＲ／Ｗ１と非接触ＩＣカード２ａ，２ｂとの間では、相互認証、メモリリード、メモリライトといった通常処理によるデータ通信が実行される（Ｓ６）。なお、いずれの非接触ＩＣカード２ａ，２ｂによってもポーリングコマンドが受信されなかった場合には、ポーリングコマンドの同期タイミングと対応する一定時間が経過したか否かが判断されることになり（Ｓ７）、一定時間が経過した後の非接触ＩＣカード２ａ，２ｂはともに双方向スイッチ１８をＯＦＦ動作させて共振回路ループを切断することになる（Ｓ５）。

【００２５】さらに、引き続き、図１１で示すフローチャートを参照しつつ、定期券である非接触ＩＣカード２ａ，２ｂの応用的な処理動作を説明する。なお、自動改札機に搭載されたＲ／Ｗ１の処理動作は図８を参照して説明した内容と同じであるから、説明を省略する。そして、ここでは、単一の鉄道路線ではあるものの乗車区間が２つに分割された路線を利用する必要上、利用者が定期券として２枚の非接触ＩＣカード２ａ，２ｂを所持しており、非接触ＩＣカード２ａ，２ｂの各々にはユーザ識別情報として共通の鉄道路線コードが記憶されている一方、これらの非接触ＩＣカード２ａ，２ｂが分割路線を利用することを示す分割コードや区間コードがユーザ識別情報として記憶されていることを前提とする。

【００２６】利用者が重なり合ったままの非接触ＩＣカード２ａ，２ｂをＲ／Ｗ１の通信エリア内で提示すると、各非接触ＩＣカード２ａ，２ｂのカード電源がＯＮ動作され（Ｓ１）、ポーリングコマンドを受信したか否かが判断される（Ｓ２）。そして、ポーリングコマンドに含まれたユーザ識別情報は非接触ＩＣカード２ａ，２ｂのそれぞれによって読み取られることになり、読み取ったユーザ識別情報の内容と記憶しているユーザ識別情報の内容とが合致するか否か、つまり、鉄道路線コードが合致しているか否かが判断される（Ｓ３）。ここで、鉄道路線コードが合致しなかった場合には、いずれの非接触ＩＣカード２ａ，２ｂも双方向スイッチ１８をＯＦＦ動作して共振回路ループを切断することになり（Ｓ４）、処理動作が終了する。また、鉄道路線コードが合致している場合には、ユーザ識別情報のうちの分割コードを読み取ったうえで分割コードの有無が判断されることになり（Ｓ５）、分割コードが無ければ、レスポンスを送信した後（Ｓ６）、Ｒ／Ｗ１との間で通常処理によるデータ通信が実行される（Ｓ７）。

【００２７】一方、分割コード有りと判断された際は、引き続き、ポーリングコマンドに含まれた駅コードと非接触ＩＣカード２ａ，２ｂに記憶されている区間コードとが読み取られることになり（Ｓ８）、駅コードが非接触ＩＣカード２ａ，２ｂいずれの区間コードに含まれているかが判断される（Ｓ９）。そして、非接触ＩＣカード２ａの区間コードに駅コードが含まれていると判断された際における非接触ＩＣカード２ｂは双方向スイッチ１８をＯＦＦ動作させることによって共振回路ループを切断することになり（Ｓ１０）、非接触ＩＣカード２ａは双方向スイッチ１８のＯＮ動作を維持したままでＲ／Ｗ１に対してレスポンスを送信する（Ｓ１１）。また、非接触ＩＣカード２ｂから読み取られた区間コードに駅コードが含まれていれば、非接触ＩＣカード２ａは双方向スイッチ１８をＯＦＦ動作させることによって共振回路ループを切断することになり（Ｓ１０）、非接触ＩＣカード２ｂは双方向スイッチ１８のＯＮ動作を維持したままでＲ／Ｗ１に対してレスポンスを送信する（Ｓ１１）。その後、Ｒ／Ｗ１及び非接触ＩＣカード２ａ，２ｂ間では、アンチコリジョン、相互認証、メモリリード、メモリライトといった通常処理によるデータ通信が実行される（Ｓ１２）。

【００２８】ところで、本実施の形態においては、Ｒ／Ｗ１が駅改札機に搭載され、かつ、非接触ＩＣカード２ａ，２ｂが定期券や乗車券などであり、Ｒ／Ｗ１及び非接触ＩＣカード２ａ，２ｂからなる非接触通信システムが自動改札システムとして利用されるとしているが、このような構成のみに限定されることはなく、例えば、以下に示すような用途例での利用も可能である。すなわち、図示は省略しているが、Ｒ／Ｗが高速道路料金所や有料駐車場などに設置された通過規制装置に搭載されており、非接触ＩＣカードが高速道路通行券や駐車券であってもよいのであり、この際におけるＲ／Ｗが送信するポーリングコマンドのユーザ識別情報と非接触ＩＣカードが記憶しているユーザ識別情報とのそれぞれに少なくとも通過許可に必要な情報が含まれているならば、複数枚の非接触ＩＣカードが重なり合って提示された場合であっても確実なデータ通信を実行し得ることになる。

【００２９】また、本実施の形態に係る非接触通信システムが交通関係のみにおいて利用される必然性があるわけではなく、Ｒ／Ｗが送信するポーリングコマンドのユーザ識別情報と非接触ＩＣカードが記憶しているユーザ識別情報との各々に対し、入退室用や現金引出用という

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ような非接触ＩＣカードの使用対象を限定するカテゴリーコードを含ませておくことも可能であり、このような構成を採用した場合には、定期券である非接触ＩＣカードと入退室用である非接触ＩＣカードとが互いに重なり合った状態で提示されたとしても容易に判別されることになり、用途に対応して適正な処理動作が実行されることになる。すなわち、以上説明した非接触通信システムの用途が交通関係のみに限定されることはないのであり、非接触ＩＣカードをパスワードやＩＤコードなどの登録用、また、Ｒ／ＷをパスワードやＩＤコードなどの確認制御用としておくことによって非接触通信システムを各種のセキュリティシステムとして利用することが可能になる。さらにまた、非接触通信媒体が非接触ＩＣカードに限定されることはないのであり、例えば、利用者が身に付けている腕時計などのような身装品に組み込まれたものであってもよいことは勿論である。

【００３０】

【発明の効果】本発明に係る非接触通信媒体、非接触情報読出／書込機及び非接触通信システムによれば、非接触情報読出／書込機から送信されている問いかけ信号に含まれたユーザ識別情報の内容と予め記憶しているユーザ識別情報の内容とが合致しなかった非接触通信媒体は自らの共振回路ループを切断してしまうので、複数枚の非接触通信媒体が重なり合っている場合であっても非接触情報読出／書込機に対する共振点が変化することは起こらず、複数枚の非接触通信媒体と非接触情報読出／書込機との間における確実なデータ通信を行うことができる。しかも、このような構成であれば、非接触通信媒体同士の重なり合いを検知するための検知手段を設けたり、重なり合いが検知された場合における切断順序の優先順位を決定するプロトコルを追加したりする必要がなくなるため、回路構成や装置全体の小型化やコストダウンを図り得るという利点も確保される。

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【図面の簡単な説明】

【図１】本実施の形態に係る非接触通信システムを模式化して示すブロック図である。

【図２】非接触通信システムを構成するＲ／Ｗを模式化して示すブロック図である。

【図３】非接触通信システムを構成する非接触通信媒体である非接触ＩＣカードを模式化して示すブロック図である。

【図４】変形例に係る非接触ＩＣカードの要部構成を示すブロック図である。

【図５】Ｒ／Ｗと非接触ＩＣカードとの間で実行される処理動作を示すシーケンス図である。

【図６】ポーリングコマンドの構成例を示す説明図である。

【図７】ポーリングコマンドの具体例を示す説明図である。

【図８】自動改札機に搭載されたＲ／Ｗの処理動作を示すフローチャートである。

【図９】Ｒ／Ｗが自動改札機に搭載され、かつ、非接触ＩＣカードが定期券である際の基本的な処理動作を示すフローチャートである。

【図１０】非接触ＩＣカード相互の動作の違いを示す説明図である。

【図１１】定期券である非接触ＩＣカードの応用的な処理動作を示すフローチャートである。

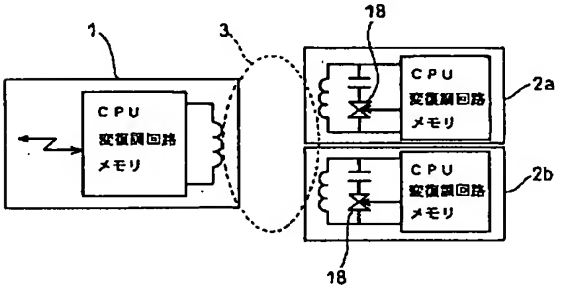
【符号の説明】

１　　Ｒ／Ｗ（非接触情報読出／書込機）

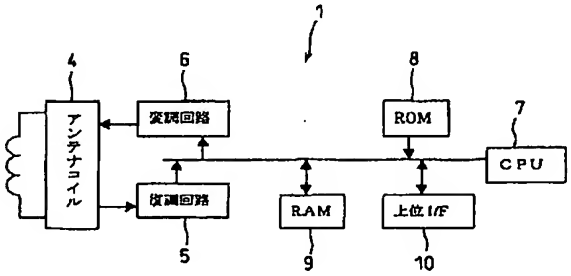
２ａ　非接触ＩＣカード（非接触通信媒体）

２ｂ　非接触ＩＣカード（非接触通信媒体）

【図１】



【図２】



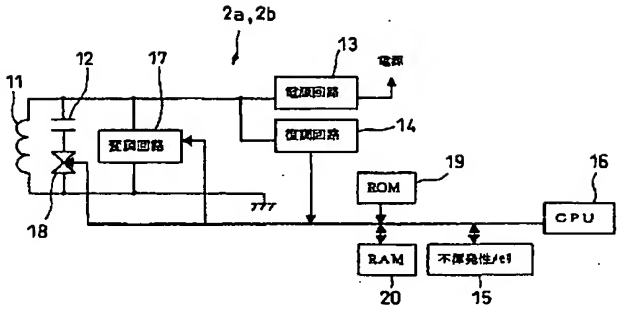
【図６】

プリアンブル	同期コード	データ長	コマンドコード	ユーザ識別情報

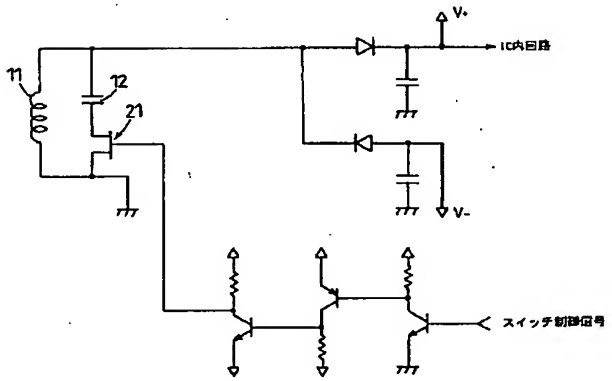
【図７】

鉄道路線コード	駅コード

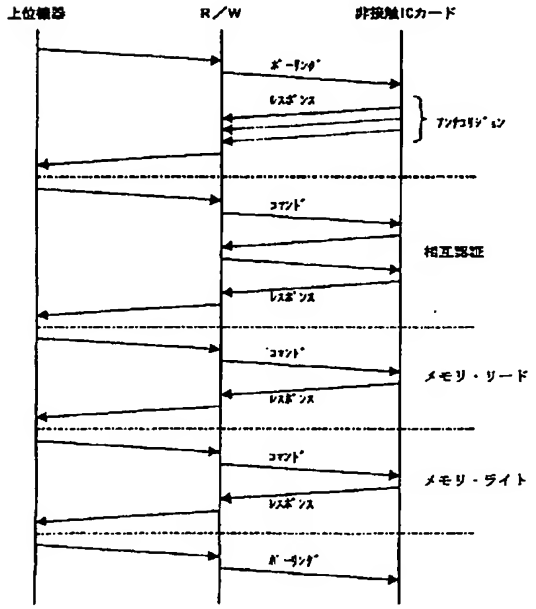
【図３】


2a,2b
11
12
17
13
14
19
16
18
ROM
CPU
RAM
20
15

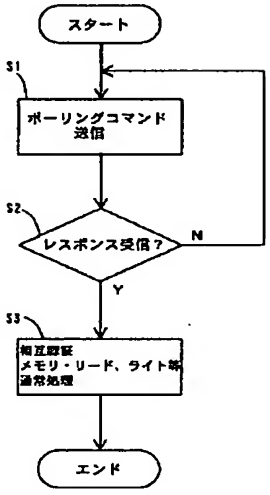
【図４】


V+
V-
11
12
21

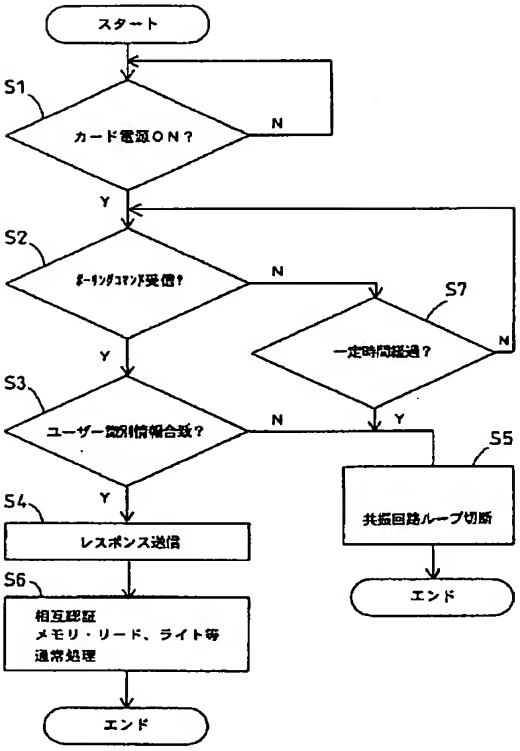
【図５】


上位機器
R／W
非接触ICカード
メモリ・リード
メモリ・ライト

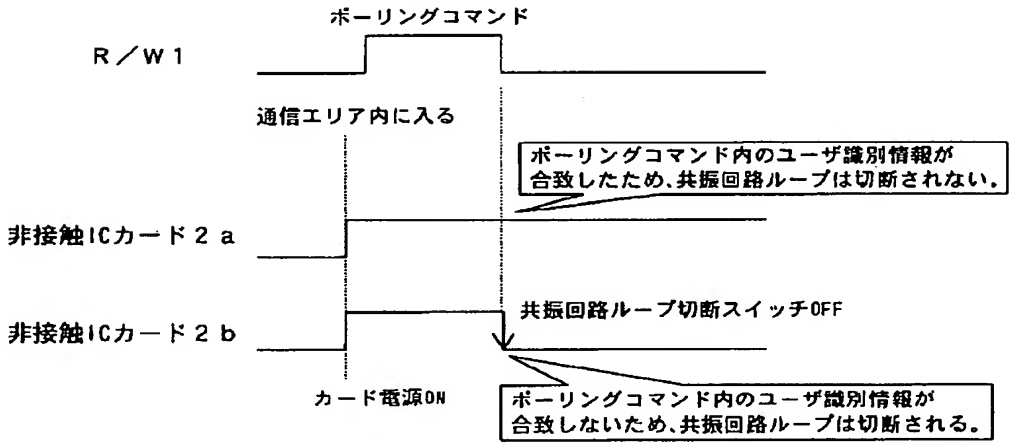
【図８】


スタート
S1
ポーリングコマンド送信
S2
レスポンス受信？
N
Y
S3
エンド

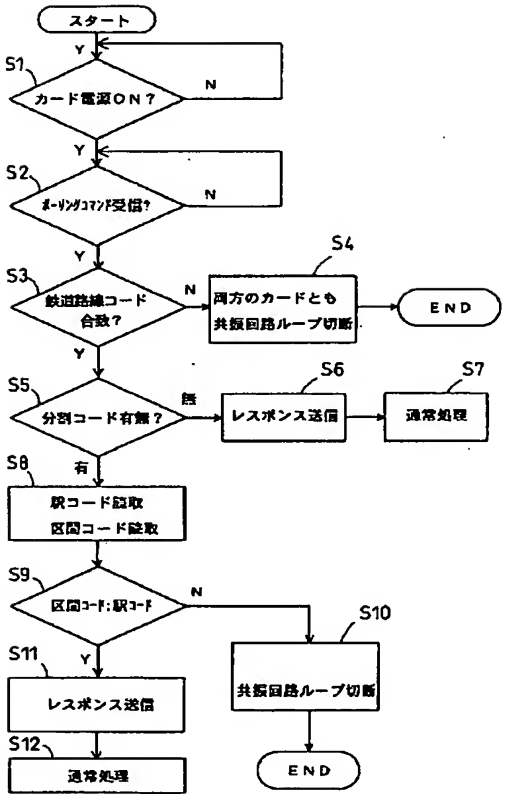
【図９】


スタート
S1
カード電源ＯＮ？
N
Y
S2
ポーリングコマンド受信？
N
S7
一定時間経過？
N
Y
Y
S3
ユーザー識別情報合致？
N
Y
S5
共振回路ループ切断
S4
レスポンス送信
エンド
S6
相互認証
メモリ・リード、ライト等
通常処理
エンド

【図１０】


ポーリングコマンド
R／W１
通信エリア内に入る
ポーリングコマンド内のユーザ識別情報が
合致したため、共振回路ループは切断されない。
非接触ICカード２ａ
非接触ICカード２ｂ
共振回路ループ切断スイッチOFF
カード電源ON
ポーリングコマンド内のユーザ識別情報が
合致しないため、共振回路ループは切断される。

【図１１】



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5/02		5/02	

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